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QUEENSLAND AGRICULTURAL JOURNAL

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Event and Comment.

The Current Issue.

The February issue is generally a good number. The interesting notes on Irrigation in Queensland, which have been going through the Journal for some months, are concluded; the tables quoted in the text have been reserved for the March Journal. Special features include a review of last year's activities in connection with Queensland stock, an informative article on pineapple-growing in Hawaii, notes on the activities of the Main Roads Board, and the first of a series of Entomological Notes. Other features traverse an extensive field, the regular article on breeds of pigs, and the second instalment of a paper on Insects Affecting Sugar-cane in North Queensland, being among the more important. Some of the contributions are excellently illustrated, and readers generally will appreciate this number.

The Cotton Industry.

At the last conference of the American Cotton-growers' Association, held in October last, resolutions bearing on the vexed question of cotton ratooning were carried. Preventive methods of checking the winter hibernation of the boll weevil, recommended by the Federal experts engaged in boll weevil experiments, were adopted. These experiments, supplemented by practical results obtained by successful cotton-growers, proved conclusively that the methods recommended could be confidently accepted. Chief among these preventive measures is the immediate ploughing up or turning under of cotton plants after harvest. This and other measures were fully approved by the conference, and every cotton-grower was urged to put them promptly into effect. Boiled down, the first preventive measure means that cotton ratooning should not be practised. To add weight to its decisions the conference further resolved to call upon bankers, merchants, and all other credit agents throughout the cotton States to check the credit for their cotton crops of all growers disregarding the preventive measures recommended by the Federal authorities. The conference also advised that for every 25 acres of land put under the plough the planting limit for cotton should be 8 acres, and that these 8 acres should be intensely cultivated. In other words growers are advised not to ratoon and to intensely cultivate small areas. Commenting editorially on the promise of cotton as a new and great Queensland industry, and referring to the efforts of the Government to found it firmly, the "Brisbane Courier" (23rd January, 1924) asserted that the Queensland growers ought to be guided by the experience of the producers in the cotton States of America, who have declared that ratoon cotton is a menace to the industry, because it provides harbourage for the dreaded boll weevil. The Queensland Government and its experts "are not banning cotton from a spirit of sheer opposition. They are doing it because science and experience say it is necessary for the salvation of the industry."

Conservation of Natural Pastures.

During the abnormally dry spell, now happily broken, nature presented very convincingly many strong arguments why the conservation of natural pastures should be regarded very seriously by every stockowner. Travelling through the country one frequently sees paddocks that, although covered by a fair growth of herbage, are entirely devoid of the original natural grasses. By overstocking and other forms of bad management grazing lands have been allowed to become eaten out and more or less useless herbage has been allowed to replace valuable native grasses. Year after year this experience is repeated, until it is now a rare sight to see a paddock with a good covering of native grasses in the more closely settled areas. This condition is not due to any vagaries of climate nor lack of vitality or seed fertility in the natural grasses; it is rather a consequence of a continuance of the bad practice of over-stocking. An occasional paddock shows evidence of good management in its covering of native grasses that will in due time seed and replenish, but pastures like that are not common. Contrarily, as a general experience, one oftener observes country eaten right out and badly stock sick. The result is that when rain comes after a dry spell weeds gain the mastery over the scantier and less vigorous grasses that through bad management have not been given a chance to re-establish themselves. In the first week of hot, dry weather the weeds and herbage wither; the first heavy wind drives the wilted and lightly rooted growth against the fences, there to be piled up to add to fire risks. The present favourable season is one in which advantage might well be taken to spell fed-out paddocks and give the natural grasses a chance to recuperate. Farmers are, of course, quite naturally tempted at a time like now to put a few more head of stock on to their grazing lands, but it would be well for them to look ahead to make sure that they are not stocking over the limit of safety.

A Vanishing Asset.

Figures in the last Commonwealth Year Book again remind us that the forest areas of Australia are diminishing. While the main objective of the settler in the past has been the improvement of grazing areas and the clearing of land for the plough by the destruction of timber, very little thought has been given to the need for re-afforestation. The enormous wealth in Australia's timber lands has become only recently to be fully appraised. Timber itself is a primary product, and in many new settlements it is often the first and most valuable crop taken off a selection. Scientists and economists the world over are concerned with forestry problems and the problem of re-planting denuded territories, but with us it seems that a decided, healthy, and forcible public opinion in favour of the conservation of one of our finest national assets needs to be created.

The Queensland Sugar Industry.

The twenty-third annual report of the Bureau of Sugar Experiment Stations, just to hand, refers to the grave anxiety that existed in sugar circles before the termination of the Federal agreement under which the industry had, to a large extent, become stabilised. The efforts towards a renewal of the covenant by the Queensland and New South Wales canegrowers, supported by the Beetgrowers' League of Victoria, are described. These efforts were strongly supported by the Queensland Government and representatives of the sugar industry, led by the Minister for Agriculture and Stock (Hon. W. N. Gillies), met the Prime Minister (Right Hon. S. M. Bruce), and urged upon him the importance of recognising the national as well as the economical value of the industry to the Commonwealth. The report stresses the strong national aspect of the question as presented by Mr. Gillies, and goes on:—"In the course of his address to the Prime Minister, Mr. Gillies said:—'We say emphatically that in the defence of this continent and the maintenance of a White Australia, the preservation and advancement of the Queensland sugar industry are involved. We believe that the industry can only be maintained and extended so as to provide all the sugar Australia requires by one or other of the methods now advocated. According to Press reports, a few days ago, you were speaking on defence and the importance of the navy. Battleships are necessary, but is not a girdle of white settlers round Australia . . . equally valuable? The new sugar-mill, costing half a million, about to be erected by the Queensland Government to open up the jungle lands of the Tully River, is as good an investment for defence as a modern battleship, for it will settle men there who will be ready to fight if needed. I am aware that there are differences of opinion regarding the policy of Government or State control of industry, but the delegation before you is made up of all shades of political thought, and it is at one on this question as far as the sugar industry is concerned. . . .'"

THE LIFE HISTORY AND CONTROL OF INSECTS AFFECTING SUGAR-CANE IN NORTH QUEENSLAND—*continued.*

BY EDMUND JARVIS, Entomologist, Bureau of Sugar Experiment Stations.

Continuation of a paper read by Mr. Jarvis before the Pan-Pacific Science Congress in Melbourne, in August, 1923.

7. Protection of Insectivorous Birds.

During the flighting season cane-beetles are greedily devoured by several of our native birds. The more useful of these are the white and the straw-necked ibises (*Carphibis spinicollis* and *Ibis molucca*); the laughing jackass (*Dacelo leachii*); and a few others.

8. Natural Control.

Insect Parasites.—Two species of Tachinidæ have been bred by us from grey-backs confined in cages.

These flies probably oviposit on the beetles while the latter are resting by day in feeding-trees in a torpid condition, and doubtless act as a minor check on their increase.

One of these parasites is slightly smaller than a house-fly and has often been bred here; the number obtained from a single beetle varying from 5 to 12.

DROUGHT AND EXCESSIVE HEAT.

Natural control resulting from the occurrence of adverse meteorological conditions at a time when beetles are waiting to emerge from the ground are of immense benefit to all concerned.

A check of this nature may at times destroy from 50 to 75 per cent. of the beetles inhabiting an area of several hundred square miles of country.

During 1915, for instance, a dry spell lasting from July to November, kept the cockchafers imprisoned for nearly two months, causing thousands that had assumed the imago condition in September to simply perish helplessly in the pupal chambers.

Quantities of these dead beetles were ploughed up towards the end of November, and noticed lying in the furrows. Again, a check of a similar nature was experienced here eight years later (1922-23), and in many quarters reduced the usual losses from grub-attack to a minimum.

A noteworthy example of natural control, affecting beetles that had been weakened by prolonged confinement underground, occurred during December, 1915, when a heat-wave lasting two days caused myriads of beetles to drop dead from the feeding-trees. The temperature on this occasion varied from 95 degrees to 98 degrees Fah., the wind being from our warm quarter (north-west). No less than 25 dead specimens were collected from beneath one tree of *Eucalyptus tessalaris* of medium size; while on an area of forest land enclosing about two square chains 98 beetles were picked up. Of these, 27 were males, 49 females, and the remainder of doubtful sex owing to mutilation by ants.

Several specimens were dissected, and in all those examined the ovaries were found to be only partially developed. Two beetles contained 27 eggs each, most of which were more than half grown.

EGG STAGE.

9. Fumigation of Soil.

Experiments to test the effect of fumigation with carbon bisulphide on eggs of *albohirtum* were initiated during November, 1921.

These were confined to the laboratory, and have not yet been confirmed by field work. Eggs placed in cages containing from 130 to 280 cubic inches of soil were given $\frac{1}{8}$ oz. injections of the fumigant, administered at distances varying from $6\frac{1}{2}$ to 8 inches.

Twenty-four hours after treatment they were removed from the earth and placed in petrie-dishes on damp soil so that developments might be easily watched. Three days later the control eggs had become noticeably larger, and remained creamy-white, while fumigated eggs were dark-brown and more or less blotched with mould. This experiment was repeated on 24th of November with varying doses of bisulphide, similar results to the preceding being obtained in every case. Control eggs ultimately produced grubs; but all eggs subjected to fumigation perished a few hours after injection of the soil.

GRUB STAGE.

Unlike many other injurious species of root-eating scarabæidæ, *albohirtum* has a life-cycle of only twelve months, so that its grubs are present beneath cane stools during about six months of every year.

Instead of an elusive beetle, we have now to consider its sluggish larval form, which, being easily located in the soil, and satisfied to remain amongst cane roots, offers a very wide field for economic research; since during this stage in its life-cycle we are able to employ several remedial measures quite different from some of those alluded to in connection with control of the imago condition of this pest.

10. Poison Baits.

Possibilities in this direction were investigated at some length by the writer during 1915-16.

After experimenting at that time with a number of different poisons—the composition of which need not be enlarged on here—the cheapest and most effective proved to be aceto-arsenate of copper. Mortality of 100 per cent. in 15 days was obtained by dusting this arsenical on cow-pea leaves and then burying same in cages of soil, each containing a third-stage grub of *albohirtum*.

Paris green mixed with three times its weight of stale flour proved fatal to about 58 per cent. of cane-grubs in one week, 75 per cent. in 15 days, and 100 per cent. after the lapse of 25 days. Buried leaves treated with arsenate of copper remained palatable and effective for about five weeks.

Being of manurial value, this cow-pea bait was considered to be the most promising of those tested, although the grubs were also found to be very partial to sliced tubers of English and Sweet potatoes, pieces of sugar cane, and various succulent roots.

In my opinion it is imperative that any poison used should be applied in a highly concentrated form.

Judging by results given above, and by those attending later experimentation (1921-23), this phase of control presents a possible key to the solution of the cane-grub problem, and is deserving of very close study.

11. Hand Collecting.

The practice of picking up grubs behind the plough has been discontinued here during the last five years, although still followed up in other sugar centres of Queensland; our Cairns growers having evidently lost sight of the fact that every grub collected in this way means one beetle less; which, if a female specimen, may prevent the presence next season of 24 to 36 grubs, a number able to destroy at least four stools of cane.

This form of control is assiduously kept up in other sugar-growing countries; notably in Porto Rico, where collecting the grubs and beetles of *Phyllophaga* is said by experts to be "the only sure way of keeping this pest from increasing."[5]

12. Soil Fumigants.

The importance of this remedial method was stressed in my monthly report for March, 1915,[6] and since that date numerous experiments were carried out here during 1915-1917. In 1921-1922 the more promising of these fumigants were further investigated, both in laboratory and field, when it was discovered that *one* of them, which had given excellent results in laboratory work during April, 1915, proved equally successful when taken into the field.

This fumigant was para-dichlorobenzene, which at that time had never been experimented with as a possible remedy for root-eating scarabæid cane-grubs, so that our Department of Agriculture may be congratulated upon its having been the first to discover a fumigant which bids fair to be of great economic value as a controlling factor against one of the world's most notorious insect enemies of sugar-cane.

In field practice, injections consisting of a-quarter of an ounce of dry crystals of para-dichlor were placed 3 inches from cane stools, 4½ inches deep, and from 12 to 18 inches apart on each side of rows; at a time when grubs were in the second instar, and the cane about 2 feet high (25th January).

When examined three months later the cane, both in treated and control area, had attained a height of from 5 to 7 feet.

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[5] Journal Dep. Agric., Porto Rico, Vol. II., No. 1, Jan., 1918.

[6] Queensland Agric. Journal, Vol. III., p. 220.

One could, however, quite easily pick out the treated from the check rows, as the cane in the former had remained green and upright, whereas the untreated cane had become drooping and yellow in many places, owing to grub infestation.

As the dry weather continued, these differences became more marked day by day, until a fortnight later we obtained conclusive ocular demonstration of the efficiency of this fumigant as a grub destroyer.

Additional field experiments are being arranged for next season, when we hope to study various modes of application, &c., with a view to reducing the cost of material and labour to a minimum.

It may be of interest to mention that during dry weather ¼ oz. of para-dichlor., when left for fifteen days underground in volcanic soil at a depth of 7 inches, and during an average temperature of 60 deg. F., lost nearly half its weight, but did not completely evaporate until the end of six weeks.

Under wet conditions, both soil infection and evaporation were retarded. In moist clay-loam soils injections of 4 drachms last ½ a drachm during eighteen days, so that under such conditions evaporation might continue during a period of about four months. The odour remains in the soil for a fortnight or three weeks after complete evaporation of the crystals.

Laboratory experiments with carbon-bisulphide and various other soil fumigants need not be alluded to in detail just now, although I may mention that some of these have yielded encouraging results.

13. Poisonous Plants.

This phase of control work, which is being studied here at present, consists in endeavouring to discover some plant which, while possessing toxic principles, will at the same time prove palatable and attractive to cane-grubs.

Several poisonous plants have been tested recently on grubs confined in cages of soil in our laboratory, with the result that interesting data of more or less value has been obtained.

14. Larvicidal Solutions.

A series of experiments of this nature were carried on by the writer in 1916, results being summarised as follows:—Creolin 1 pint, water 50 gallons, killed 100 per cent. of grubs in cages, and applied to the roots at rate of 5 quarts per stool did not injure the cane. Potassium cyanide 1 lb., water 200 gallons, killed 100 per cent. of grubs. Borax 1 lb., water 3 gallons, proved effective, but too expensive for general purposes. Creosote 8 oz., water 5 gallons, emulsified with soap, gave fair results. Saltpetre 1 lb., water 3 gallons; Barium chloride 1 lb., water 3 gallons; Hellebore 1 lb., water 12 gallons, all gave negative results.

This form of control might prove serviceable on occasion for treating small plots of cane intended for seed, &c., but is unsuitable for general practice on a big scale.

15. Introduction of Wasp Parasites.

With regard to this fascinating subject I may mention that we have recently taken steps to obtain scoliid wasp parasites of cane-grubs from Java for introduction into North Queensland.

The most promising of these appears to be *Dielisthoracica* Fab. and *D. javana* Lep., both of which are parasitic in Java on grubs of *Lepidiota stigma* and other scarabæid beetles.

As a return for these we have already forwarded to Prof. Leefmans at Buitenzorg 239 cocoons of our *Campsomeris* digger-wasps for breeding and liberation in East Java. These were packed mostly in damp charcoal dust, but other methods of packing were tried by way of experiment.

16. Natural Control (Grub-Eating Birds and Mammals).

The most useful of these are the Ibis (already alluded to under control method No. 7, which, together with the Magpie-Lark (*Grallina picata*), Jackasses, and Indian Mynas (*Acridotheres tristis*), usually follow the plough as a matter of course, and are of great use to the canegrower.

Similarly, the common Bandicoot (*Peramelea* sp.) and probably other small native marsupials destroy a minor percentage of cane-grubs whenever these chance to occur plentifully, or while they are feeding close to the surface in a more or less exposed situation, as frequently happens during excessively wet weather.

17. Indigenous Wasp Parasites.

Our two principal scoliid wasps are *Campsomeris tasmaniensis* and *C. radula*, which have a life-cycle of from seven to eleven weeks, breeding practically throughout the year.

The number of cane-grubs victimised by these two species varies apparently from about 5 to 10 per cent., their increase being efficiently checked by various controlling factors.

Three of these are the hyperparasites *Macrosiagon pictipennis* Lea, *Hyperalonia satyrus* Fabr., and a *Conopid* fly (undetermined), which subsists on the eggs and larval stages of these digger-wasps. In addition to the above checks on their increase, the Green Muscardine fungus occasionally kills both adults and maggots of *Campsomeris*, while *acari* and *bacteria* destroy many of their eggs.

An account of the life-history and metamorphosis of these interesting insects was published last year (1922) in our Agricultural Journal.[7]

Scolia formosa has also been recorded by the present writer as being parasitic on *albohirtum*, but is a comparatively rare species, and probably of very minor importance in the Cairns district.

18. Predaceous Insects.

These include two or three species of Asilidæ and one of Elateridæ, whose soil-frequenting larvæ puncture and suck the life-juices from various cane-grubs.

Other predaceous insects (Carabidæ, Formicidæ, &c.) probably destroy an insignificant percentage of larvæ of the greyback cockchafer, but have not yet been closely studied.

19. Entomogenous Fungi.

A small number of *albohirtum* grubs succumb each year from the insidious invasious of the Green Muscardine fungus (*Metarrhizium anisopliæ* Metch.) that generally appears just after commencement of our so-called wet season, being more or less in evidence throughout March, April, and May.

The occurrence of this vegetable parasite, however, is very local, and we intend trying to extend its sphere of usefulness in the near future by cultivating large quantities of spores for uniform distribution over cane areas liable to serious grub-infestation.

20. Bacterial Diseases.

The commonest of these is a species of *Coccobacillus*, which occurs spasmodically in certain localities, and, although perhaps of little value, is worth recording here.

Healthy grubs inoculated by us with this disease developed black patches on the legs and along the spiracular area resembling those known to be characteristic of *C. nigrofasciens*, and died within three to five days.

PUPA STAGE.

21. Fumigation with Carbon Bisulphide.

The pupa of *albohirtum* occupies a position of complete isolation, lying not only at a greater depth than the eggs, but being placed in a specially prepared chamber having walls lined and puddled with soil in a manner calculated to exclude small insect enemies and prevent it from either drying up or being harmed by heavy rains.

Our attempts to destroy these pupæ have been limited to preliminary experiments with carbon bisulphide, which, however, was found to kill them, both in cages of soil and outside under field conditions. Further experimentation is being planned for the coming season (1923).

LEPIDIOTA FRENCHI BLACKB.

Fortunately this cockchafer has a two-years life-cycle, and only damages cane seriously every second season. Its metamorphosis and life-history have been described in our various bulletins[8] so will not be dealt with here.

The beetle, which is of a uniform dark reddish-brown, measures about 25 by 12 mm., and emerges from the soil a week or so later than *albohirtum*. It is widely distributed throughout forest country its larvæ feeding for the most part on roots of grasses and small herbaceous plants. Unlike *albohirtum*, the beetles hide during the day in close concealment amongst the stalks and surface roots of weeds and miscellaneous vegetation.

Our experimentation as a whole has naturally embraced the grubs of both *albohirtum* and *frenchi*, since they frequently occur together under the same stool of cane.

The control methods already advocated for beetles of *albohirtum*—excepting Nos. 2, 4, 5, 8, 9, 13, and 14—are applicable also to those of *frenchi*. During the third instar the grubs of both species are very similar in general appearance, but may at once be separated by a glance at the arrangement of the phototropic bristles situated ventrally on the anal segment. Although positively phototropic, reaction of the beetles towards acetylene light is not so marked as in those of *albohirtum*.

RHABDOCNEMIS OBSCURUS BOISD.

This well-known weevil-borer appears to be on the increase, and of late years has called for repressive measures. The only control attempted here at present is the breeding and liberation in affected areas of the tachinid fly parasite, *Ceromasia sphenophori* Vill.

Our cages used for this work measure about 6 by 8 by 7 feet, and from these hundreds of flies have been bred and distributed. Results so far have been very encouraging, and this work will be continued during the coming season.

During the course of breeding experiments several improved methods of handling and tending these flies during captivity have been evolved by the writer, or which the following may be of interest to economic entomologists:—

In place of using split cane for feeding purposes we section the stick transversely into 4-inch lengths, and then stand each piece with buds pointing upwards in a pot of water (an ordinary 2-inch vaseline jar). The water, rising by capillarity, keeps the exposed upper ends of the pieces continually moist for two days or longer, so that the food remains palatable all the time and need not be renewed so often.

The common canna, transplanted when about 18 inches high into kerosene tins filled with soil, provides excellent broad leafage for spraying and shelter from heat, as the drops adhere slightly to the surface of these leaves and do not evaporate quickly. Canes used for holding borer grubs to be placed in cages should be detached from the stool after lifting same, all side roots cut away close up to the stick, the basal rooting portion washed to remove soil or ants, &c., and, having been stocked with grubs at each internode (excepting three or four at top of canes), should be planted about 6 inches apart in tins of soil, holding, for convenience of handling, from six to eight sticks. Wads used for plugging holes after inserting grubs should consist of small fragments of borer cocoons, and it is very important that the substance of these wads should not be pressed tightly together, and should be inserted loosely in the holes with just sufficient grip to keep them from falling out. For making the holes we find a 5/16-inch cork-punch to answer best.

ANOPLOGNATHUS BOISDUVALI BOISD.

Grubs of the so-called "Christmas Beetle" often occur under cane, and at times materially damage the crop.

The beetle may be observed from January to February resting or feeding during the day on foliage of *Eucalyptus platyphylla* or other food-plants. The elytra of this beautiful insect are pale creamy-grey ornamented with irridescent flashes of pink and green, its head, prothorax, and scutellum being metallic greenish-gold, and the tibiæ and tarsi purple.

PHRAGMATIPHILA TRUNCATA, WALK.

Of late years this well-known moth-borer has been troublesome in some of our sugar centres, chiefly, however, to young ratoons and plant cane. Although in evidence each season in the Cairns district, infestations are very local, seldom becoming serious, owing mainly to the occurrence of a tiny braconid wasp (*Apanteles nonagriæ* Oliff.); and in part to the presence of *Pheidole megacephala* in most of our canefields.

This braconid parasite was discovered by Oliff. in New South Wales in 1893, and recorded for the first time in Queensland by the present writer in 1919. During December, 1921, whilst breeding specimens of *nonagriæ* in cages at Meringa Laboratory we found the period occupied by its life-cycle to be only sixteen to twenty-one days; and obtained a maximum record of ninety-three eggs from one female.

This parasite is not difficult to breed, and in view of its very brief life-cycle and effective control of our large moth-borer might, if introduced elsewhere be found to attack other lepidopterous cane-borers.

Miscellaneous Insects Affecting Sugar-cane.

Many of the insects given in the following list are responsible for minor damages to the roots, stems, and leaves of cane.

Although apt to disregard minor injuries caused by individual species, such as leaf-eating coleoptera, &c., these may, nevertheless, become quite appreciable when chancing to occur over extensive cane areas.

Insects Boring Cane Stalk and Midrib of Leaves—

Polyocha sp.—Moth-borer attacking young ratoons and causing "dead-hearts."

Tineid Moth-borer (undetermined).—Habits similar to those of preceding species, but the larvæ destroy mostly very young shoots of third and fourth ratoon crops.

Opogona glycyphaga Meyr.—Bud-moth eating eyes of Badilla, H.Q. 426, &c.; gnawing surface of rind near buds, boring into soft varieties of cane.

Loxostoma sp.—Habits similar to preceding species.

Cosmopteryx sp.—Tunnelling in midrib of cane leaves.

Insects Eating "Sets" and Stalks, below ground—

Heteronychus sp.—Gnawing cavities in basal portion of young cane, causing "dead-hearts." Does serious local damage in some sugar centres.

Pentodon australis Blackb.—Habits very similar to those of the preceding insect.

Monocrepidius sp.—Preventing good "strike" by eating eyes of sets after planting.

Termes meridionalis.—Destructive to newly planted "sets."

Mastotermes darwiniensis.—Attacking and completely destroying cane sticks, leaving only the rind; sticks 3 to 4 feet are reduced to hollow tubes.

Insects Eating the Leaves—

Locusta danica Lin.

Locusta australis Brunner.—Causing serious damage at times over extensive areas by devouring the leaves, leaving only the midribs and stalks.

Atractomorpha crenaticeps Blanch.

Oxya velox Fab.

Cyrtacanthracris (plagiata?)

Cyrtacanthracris (guttulosa?)

Causing minor damages to the leaves.

Cirphis unipuncta Haw.

Cirphis lorevi Dup.

Laphygma exempta Walk.

More or less in evidence each season; and occasionally stripping cane leaves to the midrib over localised areas of considerable extent.

Chusaris rhodias Turner.

Spodoptera mauritia (Boisd.) Hamp.

Parnara mathias Fab.

Telicota augias-kreffti MacL.

Padraona marnas Feld.

Padraona hypomoloma Lower.

Melanitis leda Linn.

Mocis frugalis Fab.

Ophiusa melicette Drury.

Harmologa miserana Walk.

Occasioning minor injuries to the leaf-blade.

Rhyparida morosa Jac.

Rhyparida didyma Fab.

Rhyparida (basipennis Lea.?)

Eating holes in the leaves; of minor economic importance.

Sap-sucking Insects—

Tetigonia parthaon Kirk.
Perkinsiella saccharacida Kirk.
Aphis sacchari.
Aphis sp.
Aphis sp. (on roots and underground portion of shoots from "set").
Aleurodes berghi Sign.
Pseudococcus (*calceolariæ* Mask.?).
Ripersia sp.

Causing minor damage to the foliage, &c.

Root-eating Insects—

Lepidiota caudata Blackb.
Lepidiota consobrina Girault.
Lepidiota rothei Blackb.

Destructive to cane on areas adjoining scrub land. *L. caudata,* which displays similar habits to those of *L. frenchi,* is said to cause serious losses to growers around Babinda.

Dasgynathus australis-dejeani MacL.
Anomala australasiæ Blackb.
Isodon puncticollis MacL.
Cacachroa decorticalis MacL.

Found occasionally in canefields, but of very minor economic importance. The grubs of *Anomala,* however, occur commonly under trash and among cane roots.

CATTLE MORTALITY AT JANDOWAE—GRASS-TREE THE REPORTED CAUSE.

Accompanied by the Stock Inspector for the Dalby District (Mr. J. H. McCarthy), the Government Botanist (Mr. C. T. White) recently made an inspection for the purpose of finding poisonous plants on properties where deaths among cattle had occurred.

In all cases the cattle were running on grass-tree country and had eaten freely of it, particularly of the flowering poles. The symptoms are similar to those exhibited by cattle running on grass-tree country on the coast and commonly known as "North Coast disease," viz., stiffness of movement in the majority of cases associated with incontinence of urine. In other respects the beast appears healthy, eyes bright, temperature, respiration, and pulse normal. The stiffness increases, involving paralysis of the muscles of the back, the paralysis continuing until the beast can no longer maintain a standing position. One is forced to the conclusion that the grass-tree must be the cause of the trouble. Both on the North Coast line and on the Downs losses occur between the months of October and February. It is also further thought that the flowering pole or spike is the principal cause, and it is worthy of note that this year there has been an exceptionally heavy crop of flowering poles. Other observers are of the opinion that the young leafy shoots following on summer rains are the cause of the mortality. The explanation is probably that any part of the plant may be dangerous to stock. The flowering poles and young shoots following rain are the only parts eaten freely by cattle, the other leaves being too coarse and unpalatable for them to feed on to any sufficient extent. Cattle should therefore be kept off grass-tree country from the latter part of September to the end of February.

Feeding experiments carried out in New South Wales with the leaves of the grass-tree and in Queensland with the flowering poles gave negative results, but the experiments were probably not conducted on a scale exhaustive enough to prove conclusive.

On the grass-tree country was seen a fair growth of a grass-like plant with blue flowers (*Dianella laevis*). This plant has been suspected of poisoning stock both here and in New South Wales, and it is hoped to carry out feeding experiments with this at an early date. This was the only other reputedly poisonous plant found in the country.

As a few cows had died since their removal from the grass-tree country to other paddocks, an examination of these better class pastures was made, but nothing of a suspicious nature was revealed. A few odd plants of Darling Pea (*Swainsonia*) and Rattlepod (*Crotalaria*) were observed, but in neither was in sufficient quantity of be harmful to stock.

UPPER BURNETT SETTLEMENT.

MULGELDIE DEMONSTRATION AREAS.

Four demonstration plots, comprising a total area of 80 acres, typical of different classes of land to be found in the Upper Burnett, were established by the Department of Agriculture and Stock under the direction of the Director of Agriculture (Mr. H. C. Quodling) in June of last year.

The objective aimed at was to demonstrate the capacity of these lands to produce profitable cotton, grain, and fodder crops, and to engage in experimental work of a practical nature with which to provide data of benefit to incoming settlers.

Attention was also given to seed selection in connection with cotton, for the purpose of developing special strains of seed for the locality.

A climatological station was established to record definite data, which, in addition to the ordinary services, embraces:—

- Registration of the amount of evaporation from a water surface;
- Automatic recording of changes of temperature, both night and day, by means of a thermograph;
- Recording of soil temperatures at different depths; and
- Monthly tests of the amount of moisture present at regular depths in the soils on experiment plots.

Official Rainfall Records.

Monthly averages, taken over period of thirty-two years—

	Points.
January	425
February	332
March	313
April	139
May	159
June	197
July	124
August	124
September	152
October	229
November	241
December	371

Yearly average: 28.86 inches.

From this table it will be seen that the Upper Burnett compares favourably with most of our recognised agricultural districts. Most of the rain falls between October and March, a period coinciding with the sowing and first picking of the cotton crop. The district is suitable for the growing of summer crops.

With the adoption of good farming methods, and by paying attention to the conservation of soil moisture, many winter fodder crops may also be grown to advantage.

Details of Demonstration Areas.

Plot No. 1—Hurdle Gully.

Soil:—Light brown clayey loam, overlying sandy subsoil.

This soil is of fairly good quality and suitable for the production of cotton and fodder crops. An analysis of the soil from this plot shows it to be a little deficient in phosphates.

The plot was well prepared and sown early in November, 1922, with Durango cotton, maize, cowpeas, feterita (grain sorghum), and Japanese millet. A number of small trials were carried out with different varieties of sorghums, panicums, and millets.

Yields from the cotton and maize were rather low, owing to the light rains during the normal wet season. February proved to be the driest month experienced in this district for a period of fully forty years.

Other summer fodders, including cowpeas, gave good returns.

YIELDS PER ACRE.

—	Fodder.	Grain.
Feterita	12 tons greenstuff	30 bushels
Manchurian Millet	2 tons of cured hay ..	..
Japanese Millet	1 ton 11 cwt. cured hay ..	..
Imphee	18 tons green fodder ..	..
Cowpeas	4 tons green fodder ..	10 bushels seed
Maize	15 tons green fodder ..	..

Plot No. 2—Camp Site, 8-Mile Dip Yards.

Soil:—Sandy, merging into light grey loam overlying a heavy clay subsoil.

A rather poor soil typical of some of the second-class lands used for grazing in this locality.

This plot was sown with cotton, cowpeas, peanuts, and Sudan grass in November last, and produced some good crops. Sudan grass grew to a height of 6 feet and produced 3 tons of dried hay per acre, in spite of the adverse season. Peanuts yielded 1,250 lb. of nuts per acre, the sample being of good quality. Cowpeas gave 1½ tons cured hay, and the portion harvested for grain yielded 8 bushels of seed per acre. The oats (Algerian) failed to mature.

Plot No. 3—Alluvial Flat, Three Moon Creek.

Soil:—Alluvial loam of considerable depth.

A first-class soil, ideal for lucerne growing. A small area of Hunter River Broadleaf sown this year, in July, made excellent growth. The plants rooted well and produced a good length of stalk, with an ample supply of leaf.

Huban clover (*Melilotus* spec.) sown a little earlier than the lucerne, made a very satisfactory start and promises to give a good return as soon as the plants are well established.

A series of fodder test plots were laid out on this block in the autumn to try out various cereals and cereals in combination with field peas.

FODDER TESTS—YIELDS PER ACRE—WINTER, 1923.

—	"Florence" Wheat.		"Florence" Wheat and Peas.		Rye.		Rye and Peas.		Skinless Barley.		Skinless Barley and Peas.		Cape Barley.		Cape Barley and Peas.	
	Tons	cwt.	Tons	cwt.	Tons	cwt.	Tons	cwt.	Tons	cwt.	Tons	cwt.	Tons	cwt.	Tons	cwt.
Green weight	8	18	8	19	4	7	4	5	8	1	8	2½	6	15	6	12
Weight cured hay	3	4	3	4	1	12	1	7	3	2	3	2½	2	5	2	1

Plots laid down.—12th June, following 270 points of rain.

Cut for hay.—Wheat, rye, skinless barley on 21st September, and Cape barley on 5th October.

Growing period—14 weeks 3 days.

Rainfall during growing period—268 points.

Plot No. 4—Area 40 acres; Monto Scrub (Brigalow with a little belah and softwood).

Soil:—Dark brown loam, rich in vegetable matter. Subsoil—Dark-grey coloured clay.

Scrub was felled in August, 1922, and a good burn obtained at end of November. Rhodes grass seed was broad-casted at end of January, a good germination taking place after the March rains.

A splendid stand of grass was obtained, which seeded before the first frost.

These scrub soils are fertile, and, when improved, make excellent dairying country; the clay sub-soil holds the moisture over long periods of dry weather. Soils of this description and the lighter classes also are suited for the production of cotton crops. Evidence of development work on country of this character is to be seen in the Mundubbera and Holywell districts.

Conservation of Natural Grasses.

The flats adjacent to the creeks running through the settlement annually produce large supplies of excellent grasses well suited for the production of bush hay. To demonstrate this fact the grass on an area of eight acres near Three Moon Creek was mowed and made into hay last March. This was stacked and fed to the working horses during the winter months, being used in conjunction with panicum and cowpea hay. The horses showed a preference for the bush hay and kept their condition well, although working constantly.

The principal tall-growing grasses on these flats are:—Kangaroo grass (*Anthistiria ciliata*), Blue grass (*Andropogon intermedius*), Wild sorghum (*Andropogon* sp.), and an assortment of herbage and grasses which have established the district's reputation as an excellent stock-carrying and fattending area.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF DECEMBER, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALLS DURING DECEMBER, 1923 AND 1922, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Dec.	No. of Years' Records.	Dec., 1923.	Dec., 1922.
North Coast.	In.		In.	In.
Atherton	7·57	22	6·51	12·12
Cairns	9·02	41	7·18	1·97
Cardwell	8·44	51	7·51	7·71
Cooktown	6 98	47	1·98	1·54
Herberton	5·69	36	4·46	6·08
Ingham	7·16	31	7·12	5·85
Innisfail	12·05	42	13·39	4·41
Mossman	12·24	51	6·86	4·42
Townsville	5·55	52	2·04	6·82
Central Coast.				
Ayr	3·91	36	3·07	5 94
Bowen	4·48	52	3·26	7·34
Charters Towers ...	3·63	41	2·66	6·12
Mackay	6·87	52	2·86	5·86
Proserpine	8·83	20	4·16	7·59
St. Lawrence ...	4·62	52	2 58	11·16
South Coast.				
Biggenden	4·44	24	5·13	3·61
Bundaberg	4·73	40	3·78	4·79
Brisbane	4·93	72	2·92	4·59
Childers	5·42	28	8·13	8·67
Crohamhurst ...	6·83	30	9·09	8·96
Esk	4·40	36	6·30	6 22
Gayndah	3·93	52	7·91	4·26
Gympie	5·74	53	5·19	6·30
Glasshouse Mts. ...	6·70	15	...	6·44
Kilkivan	4·27	44	7·85	3·94
Maryborough ...	4·69	52	5·59	6·38

Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Dec.	No. of Years' Records.	Dec., 1923.	Dec., 1922
South Coast—continued:	In.		In.	In.
Nambour	6·26	27	6·62	5·15
Nanango	3·74	41	6 06	5 19
Rockhampton ...	4·69	52	3 41	4·13
Woodford	5·39	36	7·58	4 66
Darling Downs.				
Dalby	3·07	53	7·92	1·80
Emu Vale	3·61	27	3·99	4 35
Jimbour	3·13	35	3·67	2·16
Miles	2·58	38	7·35	4·16
Stanthorpe ...	3·53	50	2·91	5·87
Toowoomba ...	4·19	51	7·35	3·78
Warwick	3·51	58	3·55	4·29
Maranoa.				
Roma	2·40	49	3·68	5·30
State Farms, &c.				
Bungeworgorai ...	3·03	9	1·94	7·10
Gatton College ...	3·43	21	3·88	3·08
Gindie	2·67	24	4·28	3·98
Hermitage ...	3·08	17	3·40	3·85
Kairi	7·05	9	2·34	4·06
Sugar Experiment Station, Mackay	8·12	26	3·16	4·85
Warren	3 83	9	1·38	4·1[illegible]

NOTE.—The averages have been compiled from official data during the periods indicated; but the totals for December, 1923, and for the same period of 1922, having been compiled from telegraphic reports, are subject to revision.

GEORGE G. BOND,
State Meteorologist.

REPORT ON EGG-LAYING COMPETITION—QUEENSLAND AGRICULTURAL COLLEGE, DECEMBER, 1923.

Changeable weather caused a decrease in the laying of the competition birds. The heat wave on the 18th-19th of December caused ten deaths, and a great many of the birds were affected to some extent. In the light breeds Mr. G. W. Hindes leads with 141 eggs, next is Mr. N. A. Singer with 140 eggs. In the heavy breeds Mr. R. Burns leads with 124 eggs, with Mrs. E. Gallagher's birds 122 eggs. Mr. R. Burns' "E" bird has finished a sequence of 57 eggs.

The following are the individual records:—

Competitors.	Breed.	Dec.	Total.
	LIGHT BREEDS.		
*C. H. Singer	White Leghorns	138	1,229
*W. and G. W. Hindes	Do.	141	1,219
*N. A. Singer	Do.	140	1,210
*Oakleigh Poultry Farm	Do.	124	1,116
*Ancona Club	Anconas	113	1,063
H. P. Clarke	White Leghorns	132	1,045
*S. L. Grenier	Do.	108	1,039
*Beckley Poultry Farm	Do.	119	1,034
*J. W. Newton	Do.	122	1,021
*R. C. J. Turner	Do.	131	1,015
*Mrs. L. Andersen	Do.	16	1,004
*O. Goos	Do.	112	983
*Rock View Poultry Farm	Do.	104	977
*Geo. Williams	Do.	109	965
*J. A. Manson	Do.	110	954
*Bathurst Poultry Farm	Do.	108	937
F. Sparshott	Do.	64	929
*Arch. Neil	Do.	102	925
*J. W. Short	Do.	90	917
*Mrs. R. Hodge	Do.	96	906
*J. Purnell	Do.	109	879
*A. C. G. Wenck	Do.	82	869
*H. Fraser	Do.	100	869
Jas. Hutton	Do.	66	864
G. Marks	Do.	53	852
G. E. Rogers	Do.	82	850
W. Becker	Do.	72	825
W. A. and J. Pitkeathly	Do.	76	825
*N. J. Nairn	Do.	103	812
J. Harrington	Do.	76	806
E. Ainscough	Do.	87	801
W. and G. W. Hindes	Brown Leghorns	76	787
C. Quesnell	White Leghorns	56	779
Chapman and Hill	Do.	65	764
*Mrs. E. White	Do.	82	761
Jas. Earl	Do.	54	747
Parisian Poultry Farm	Do.	100	668
	HEAVY BREEDS.		
*R. Burns	Black Orpingtons	124	1130
*W. Becker	Chinese Langshans	116	1100
*Jas. Potter	Black Orpingtons	112	1086
*Mrs. A. E. Gallagher	Do.	122	1077
*Jas. Ferguson	Langshans	115	1064
*Jas Hutton	Black Orpingtons	84	994
*Mrs. A. Kent	Do.	95	972
*Parisian Poultry Farm	Do.	..	969
J. N. Mants	Do.	..	964

EGG-LAYING COMPETITION, QUEENSLAND AGRICULTURAL COLLEGE—*continued*.

Competitors	Breed.	Dec.	Total.
	HEAVY BREEDS—*continued*.		
*E. Walters	Black Orpingtons	100	966
*T. Hindley	Do.	102	962
J. R. Douglas	Do.	76	925
W. T. Solman	Do.	81	913
*R. Holmes	Do.	94	911
*H. M. Chaille	Do.	91	900
*E. F. Dennis	Do.	80	916
H. B. Stephens	Do.	117	876
*C. C. Dennis	Do.	86	874
R. Conochie	Do.	77	871
*J. H. Jones	White Wyandottes	90	855
Beckley Poultry Yards	Do.	84	841
G. E. Rogers	Do.	70	820
A. McAllister	Do.	65	810
D. F. Ruhl	Do.	79	806
Jas. Ferguson	Plymouth Rocks	69	762
W. G. Badcock	Chinese Langshans	64	730
J. Rye	Black Orpingtons	80	725
F. J. Murphy	Do.	83	707
Jas. Ferguson	Rhode Island Reds	60	606
Mos. Stephens	Do.	56	576
Totals		5,990	60,954

* Indicates that the pen is being tested singly.

DETAILS OF SINGLE HEN PENS.

Competitors.	A.	B.	C.	D.	E.	F.	Total.
			LIGHT BREEDS.				
C. H. Singer	185	250	202	178	194	220	1,229
W. and G. W. Hindes	189	211	200	179	223	217	1,219
N. A. Singer	177	213	225	211	192	192	1,210
Oakleigh Poultry Farm	197	197	176	174	195	177	1,116
Ancona Club	161	186	221	145	161	189	1,063
H. P. Clarke	189	142	187	162	186	179	1,045
S. L. Grenier	152	178	197	170	176	166	1,039
Beckley Poultry Farm	175	159	150	180	184	186	1,034
J. W. Newton	183	174	165	152	170	177	1,021
R. C. J. Turner	164	173	170	166	155	187	1,015
Mrs. L. Andersen	144	175	184	179	165	157	1,004
O. Goos	143	171	181	167	154	167	983
Rocklea Poultry Farm	176	189	174	164	139	135	977
Geo. Williams	179	182	147	162	148	148	965
C. A. Goos	158	173	133	170	148	162	944
Bathurst Poultry Farm	163	163	130	174	160	147	937
A. Neil	137	166	135	173	168	146	925
J. W. Short	158	144	156	151	168	140	917
Mrs. R. E. Hodge	146	153	147	163	157	140	906
A. C. G. Wenck	153	144	127	149	135	161	869
J. Purnell	147	146	148	141	160	137	879
H. Fraser	151	139	140	148	152	139	869
N. J. Nairn	148	113	148	135	132	136	812
Mrs. E. White	99	132	151	146	135	98	761

EGG-LAYING COMPETITION, QUEENSLAND AGRICULTURAL COLLEGE—*continued.*

DETAILS OF SINGLE HEN PENS—*continued.*

Competitors.	A.	B.	C.	D.	E.	F.	Total.
			HEAVY BREEDS.				
R. Burns	198	191	171	163	256	151	1,130
W. Becker	188	191	196	182	179	164	1,100
Jas. Potter	167	198	173	174	172	202	1,086
Mrs. A. E. Gallagher	170	187	181	183	176	180	1,077
Jas. Ferguson	191	199	176	163	162	173	1,064
Jas. Hutton	179	166	170	163	158	158	994
Mrs. A. Kent	142	189	137	203	152	149	972
Parisian Poultry Farm	137	154	157	183	175	163	969
J. M. Manson	152	141	173	187	159	142	954
E. Walters	191	193	149	138	145	150	966
T. Hindley	163	176	178	168	145	132	962
E. F. Dennis	161	166	153	148	137	151	916
R. Holmes	134	133	156	148	166	174	911
H. M. Chaille	139	169	166	147	134	145	900
C. C. Dennis	151	166	117	150	145	145	874
J. H. Jones	156	154	142	130	119	154	855

FEEDING OF LIVE STOCK.*

By-Products of Sugar and Cotton.

Most valuable by-products from sugar-cane and cotton play an important part in the feeding of live stock. Molasses is of considerable value for the manufacture of huge quantities of alcohol and acetate of lime, materials used in the production of cordite, now so extensively used in warfare. It is its great worth as a food mixture for live stock with which the present article intends to deal. The boundary between summer and winter rains in Australia stretches from a point a few miles to the north of Carnarvon in Western Australia along a line striking across the Continent, in a south-easterly direction, and finishing near Eden in New South Wales. The line is somewhat irregular in New South Wales, over a great portion of which State uniform rains are experienced. Summer monsoonal rains occur over the nortern parts of Western Australia, the Northern Territory, and the northern portion of New South Wales, with the result that green grass is usually available in those parts for stock during the summer months. Southward of the line of demarcation between the two sets of rains, previously mentioned, summer downpours seldom occur, the main dependence of the agriculturists being upon the winter falls, which, as a rule, are of very regular occurrence. When a summer rain does occasionally happen along it is not looked upon with favour by many Southern farmers, who know that if the grass seed is encouraged to ''shoot'' too soon in the season there is every likelihood of the young grass being withered by the dry weather that supervenes.

Absence of Green Feed.

The absence of summer rains in Southern Australia means the non-appearance of green feed, except where irrigation plants are in operation, during the summer. This is the main reason why South Australia will never have the same opportunities of developing the dairying industry compared with Queensland. Continuous feeding on dry foodstuffs in summer has a bad effect on live stock in the South, and in drought periods many cattle die from what is known as ''compaction,'' or ''dry Bible,'' and even the death of sheep occurs at times from this complaint. Compaction results from a mass of dry food becoming lodged in the animal's stomach, and the absence of some succulent food to help carry it out of the system. The name ''dry Bible'' arose through masses of dry food having been found to have collected in that portion of a cow's stomach known as the ''Bible''—similar to the leaves of a book, and post-mortem examinations showed that the lining of the stomach had perished, and pulverised easily when touched.

* ''The Courier,'' Brisbane.

Heavy Losses from "Compaction."

Serious losses of cattle, particularly milch cows, have occurred in the past in Southern Australia during droughts, but since the reason of the deaths has become more widely known and preventive measures taken the number of deaths has been reduced considerably. Green feed not being available for mixture with the dry foodstuffs for the great majority of cattle the owners when trouble is threatened do the next best thing—mix molasses with the feeds. This by-product of sugar manufacture has been found of great service in preventing "compaction," and is easy to mix with the cattle feeds. Greater difficulty was experienced at first in feeding it to sheep in the grazing paddocks, but now the usual method is to mix the molasses with the sheep's drinking water. The molasses helps to break down the hard, fibrous nature of the dry food and bring it into a condition that enables it to be passed more readily through an animal's stomach. Where Queensland owners of cattle and sheep have been compelled to feed them on the leaves of trees, suitable for forage, in drought times they will find molasses of considerable service to them.

Cotton Seed Meal.

As the cotton-growing industry expands in Queensland it will be found that the oil-cake of cotton seed is a most valuable cattle-feeding substance. It has proved an excellent feed for dairy cows, giving particularly fine results when fed, with proper precautions, in the vast cotton-growing belts of country in the United States of America. The cotton bush is a drought-resister, and its leaves being relished by stock provide the owner with a valuable forage in dry periods. Care must be exercised at first in the feeding of cotton-seed meal to cows not used to it. A beginning should be made with not more than ¼ to ½ lb. per head per day, this quantity being gradually increased until 3 to 6 lb. has been reached. The meal is adulterated at times in America, and many dairymen insist upon the seller giving a guarantee that it contains from 41 to 46 per cent. of protein. Cotton-seed meal has a tendency to harden the butter, a matter of important consideration in hot climates. A test held in Kentucky disclosed that this meal when fed to cows kept on pasture gave a larger milk yield than when bran was used. Like results were obtained in similar experiments, but generally it was found that cotton-seed meal should not be given as the only grain ration, and should not be supplied in large quantities. A most effective ration is said to be 6 lb. of cotton-seed meal and 4 lb. of bran. The meal has also been found to increase the yield of milk when a proportion of maize meal has been added to the ration. Injurious results are believed to have arisen at times by supplying cows with cotton-seed meal by itself without mixing it with other feeding stuffs. In tests in New Jersey protein supplied by means of cotton-seed meal produced milk for 6d. less per 100 lb. and butter for 1½d. less per lb. than in the case of bran, or dried brewers' grains. Good results have been obtained from a mixture of meal and ensilage made of green maize. Excessive quantities of the meal, however, have a bad effect upon butter, and experiments have shown that it is better economy to feed 6 lb. per head daily than 7, 8, 9, or 10 lb. Occasionally cotton seed has been used in place of cotton-seed meal; but the butter in such cases has proved to be of better quality when the cotton seed was steamed than when it was fed either raw or roasted.

As wheat is produced in large quantities on the Darling Downs and in the Maranoa district, and as we have our flour mills in Brisbane and elsewhere, at which the bran is separated from the softer portion of the grain, it will be seen that Queenslanders are exceedingly well off as regards the provision of by-products—molasses, cotton-seed meal, and bran—for feeding to their live stock.

RAINFALL AT THE BRISBANE BOTANIC GARDENS.

The rainfall figures at the Brisbane Botanic Gardens for the last nine years are as follows:—

1915	24·76 inches.	1920	40·40 inches.
1916	50·58 inches.	1921	56·36 inches.
1917	40·05 inches.	1922	37·76 inches.
1918	23·81 inches.	1923	23·33 inches.
1919	21·28 inches.		

The average rainfall for Brisbane is 46 inches; and, as the rainfall at the Botanic Gardens for 1923 was only half that figure, the severity of the season of 1923 will be apparent.

SUGAR: FIELD REPORTS.

The Director of the Bureau of Sugar Experiment Stations (Mr. H. T. Easterby) has received the following report, dated 22nd January, 1924, from Mr. A. P. Gibson, Acting Southern Field Assistant:—

Beenleigh.

Seasonal conditions have been extremely adverse at Beenleigh. Only 24 inches of rain were recorded from 1st January, 1923, to the end of November. Since November heavy rains have been frequent, and surface supplies of water have been replenished. Cane-growing is carried on in conjunction with mixed farming, and the small quantity grown on the scattered fertile areas is treated by a number of very small mills.

Mr. Heck has recently improved his factory, and before commencing the 1924 crushing he hopes to have 5 miles of a 2-ft. tram completed.

The principal variety grown is D. 1135. Q. 813 and H.Q. 285 should be given a trial, and the variety known as Purple Top (N.G. 64) should be discarded.

The cane here seems fairly free from pests and diseases. Grubs and *Pentedon australis* were located, but were causing little destruction.

The 1924 crop looked well, and should favourable conditions continue, more than double last year's tonnage will be harvested.

Mooloolah.

This district is situated on the North Coast Line, 54 miles from Brisbane, 11 miles from the Nambour sugar-mill, and about 90 miles from Mount Bauple. The residents consider they have land and water enough to raise a tonnage of cane sufficient to profitably run a mill of their own, and for this end they are striving.

It is obvious that to raise cane successfully and in quantity sufficient to run a mill, it is necessary to have (1) enough suitable soil; (2) freedom from frost; (3) a good annual distribution of rain, and other suitable climatic conditions.

From Landsborough to Woombye there are about 10,000 acres of land convenient to the North Coast line and suitable for canegrowing; of this total, 5,000 acres (1,500 of which are said to be highly situated) are located in the Mooloolah valley.

This valley extends from a point below Maleny on the coastal side of the Blackall Range. From a narrow glen it widens seaward into an extensive treeless plain. Not long ago this valley was clothed by dense vine scrub; now the soil is covered by a green mat of paspalum grass, with here and there small patches of cultivation. The soil is mostly alluvial, light to black in colour, and overlaying a clay subsoil at varying depths. It is composed of wash intermingled with disintegrated particles of sandstone, which is found outcropping on the surrounding heights.

Rainfall.—The monthly average record of rainfall here for nineteen years ending 1917, as compiled by Mr. Hunt on figures given by Mr. W. T. Paget, is interesting and speaks for itself:—

	Monthly Average for 19 years.	1923 Rainfall.
January	9·07	6·59
February	13·31	5·84
March	12·93	7·34
April	7·31	20·48
May	5·50	1·36
June	4·98	3·20
July	3·89	5·16
August	3·08	1·31
September	3·56	2·00
October	3·55	1·14
November	4·55	5·16
December	8·39	8·21
	80·12 inches	67·79 inches

The Eudlo valley, of similar formation and 3 miles distant, was also visited, but is not so extensive as Mooloolah valley.

These two valleys, including their lesser contributaries, possess much good soil not subject to severe frosts; healthy banana groves seemed to prove this.

Actual cane cut year 1922	200 tons
Actual cane cut year 1923	750 tons
Estimated to cut from over 100 acres planted, 1924 ..	2,000 tons

The average commercial cane sugar is said to be 12·5 per cent.

Mount Bauple.

This area looked promising, but the summer heat was rapidly drying up the cane fields, especially those that had been neglected.

The rainfall for 1923 was only 32·45 inches, 1·34 in. better than the preceding year. The district was highly favoured in December; some 5·57 inches of rain fell, which forced the 1924 crop along. Since then little rain has fallen, and owing to the substrata not having had a saturation for some time, it is obvious that this surface moisture will soon be lost, unless followed by further rains. Many farmers do not seem to realise the great importance of conserving ground moisture. This loss may be retarded by the timely use of surface mulching implements and green manuring. The former mentioned forms a protective layer of fine soil, which hinders the upward movement of water by capillary attraction to the surface, and is highly efficient in retaining water. Green manuring forming humus improves the water-retaining powers of soils and arrests the contraction and expansion of soil.

The principal variety grown is D. 1135, and of the many varieties tried none so far compare or are as suitable for the district as D. 1135. It is a common practice here to make cane drills with 5 ft. centres, and to plant the seed 3 ft. apart. The width of the row should be determined by the variety intended to be planted, fertility of soil, and a space that can be most conveniently cultivated. Accumulated experience points to close planting of seed in drills as being more profitable for the following reasons:—(1) It minimises the expense of supplying wants; (2) less land to keep clean; (3) reduction in evaporation by winds and sun; (4) a continuous wall of cane which helps to support a heavy crop during heavy winds; and (5) increased tonnage, which usually means more sugar per acre.

The factory, besides obtaining cane from the adjacent lands, draws a big proportion of its crop from outside areas, such as Pialba, Yerra, and other places situated along the North Coast line, a small supply even coming from Samford. Provision is being made to hasten transportation of cane over the Gundiah Range by placing a siding on the range top, thereby reducing the running time and increasing the loco. load to the mill yard.

Pialba.

The sugar lands of Pialba are close to the sea, and are consequently favoured by a satisfactory rainfall. These lands are undulating and are of a light, rather shallow scrub soil, formed in most cases by the disintegration of sedimentary rocks and extending back about 3 miles from the seashore. The principal variety grown and one at present giving satisfaction is the D. 1135. Some other varieties are being tried, and although looking well, are not considered equal to the D. 1135. M. 1900 should do well on some of these soils, but it is regarded as a shy ratooner. The age and time of cutting often influences ratooning.

The area under cane has increased very much in the last few years, owing partly to the failure of fruit. The crop looked healthy and was growing vigorously. Pests and diseases are not serious. A few grubs and moth borers were observed, the latter being more often found in dirty fields or near grassy headlands.

Cultivation might be improved. Growers who have cultivated judiciously have been rewarded; their crops possess a superior colour and are further advanced.

Present prospects are bright, and a big cut expected for 1924.

The Northern Field Assistant (Mr. E. H. Osborn) reports, under date 18th December, 1923:—

South Johnstone.

The dry conditions so evident elsewhere were also in force in this area, the total rainfall so far registering 70·29 inches. Despite such dry conditions, the estimated tonnage had gone up very considerably since the commencement of the season.

The cane crop in general was flourishing, both on the red soils and alluvial.

About 400 acres had been replanted, owing to a bad early strike.

El Arish (Soldiers' Settlement).

The rainfall amounted to 80·57 inches to date. Some good fields of cane were seen, more especially upon the reddish soils. Quite a lot of extra clearing had been done, and a fair acreage of planting had also been carried out. A heavy crop of cane should be cut in 1924.

El Arish is a very prosperous little township, and its accessibility to the larger towns by the opening of the North Coast line has increased its importance as a flourishing settlement.

Tully and Banyan.

The North Coast Railway is going ahead very rapidly, and settlement is increasing at a great rate.

Adjacent to the mill site clearing is being carried out, and early in the new year this area should be an exceedingly busy one.

A large area has been planted, mostly in August last. In many cases the planting has been upon open country, and ploughing was carried out with the aid of tractors, of which there are already four in the district.

The rainfall (Banyan Post Office) had amounted to 84·44 inches.

Near the mill site several ''ranches'' have been established, but the residents and the travelling public in general are hoping that another State hotel will be established and run upon the same efficient lines that make the Babinda Hotel so very popular. It is certain that the progress of this area in the very near future will make such an undertaking a necessity.

Cane Varieties.—In South Johnstone, El Arish, and the Tully, Badila is the principal cane grown, and certainly grows to great advantage in such soils. E.K. 28, H.Q. 458, and Tableland Badila in small quantities are also doing well.

Pests.—Very few grubs have shown up this season, and the same may be said of borers. Tachinid flies have been liberated in various parts of the South Johnstone area by the Meringa Experiment Station staff, with very successful results.

Babinda.

Although the rainfall locally amounted to 95·61 inches, it was a very long way below the average, but it was most surprising to see how very well the cane looked throughout all the large area, both plant and ratoons showing good growth. This was most noticeable in some of the more medium lands carrying a large proportion of granite grit, and which would be expected to show the effects of dry weather to a marked extent. Such, however, was not the case, and some heavy crops had been harvested upon these and also upon some of the low-lying and heavier clay soils. The resultant ratoons also looked so remarkably well in most cases that it was hard to realise how dry the conditions had been. Since the early part of the season the estimates have had to be increased considerably, and at time of writing the crushing was expected to run into the last week in January. The quality of the cane crushed has so far been very good; for instance, the mill average for the week ending 27th November was represented by 15·24 c.c.s. Some very heavy crushings had also been put through, and 16,500 tons of sugar sent away.

Varieties of Cane.—Apart from Badila there is a small proportion of the Gorus, D. 1135, H.Q. 426, and a much smaller percentage of newer canes, such as Q. 813, Tableland Badila, Q. 903, and E.K. 28. Of these, Q. 813 shows up the best in similar soil. Mr. T. Stewart, of Fig-tree Creek, cut a 10-months-old plant crop of this variety, going 25 tons per acre, for a density of 14 c.c.s., at a time when the mill average was only 13 c.c.s. He now has a 7-acre block of it, planted in August, and looking very green and vigorous.

Diseases.—Leaf scald was noticed in various scattered parts of the district, in N.G. 15 (Badila), H.Q. 426 (badly infected where seen), N.G. 24B (Green Goru), and in a few stools of B. 208. In young plant Badila odd leaves of it showed the leaf markings, but hardly any dead shoots were found, whilst in some 2nd, 3rd, and 4th ratoons recently cut and to be cut, a slight proportion were either withering up or were dead. In Green Goru, however, plant cane yet to be cut had the symptoms badly with dead tops in many places, and in several blocks of recently-planted cane odd shoots and sets were either dead or dying.

Whether dry weather conditions are responsible or not, it seems that ''leaf scald'' is more evident in this area than formerly, and the advisability of growers planting none but the very best seed cannot be emphasised too strongly, and this taken from a paddock that shows no symptoms of disease. Unless this is done, the chances are that this disease will gain a very strong hold, necessitating drastic steps later on.

Mulgrave.

The mill was handling its large crop with great efficiency. For the week ending 1st December some 6,044 tons of cane had been crushed.

The Northern Field Assistant (Mr. E. H. Osborn) report under date 28th January, 1924:—

Cairns.

The exceedingly dry conditions prevailing for so long in this area changed in the middle of December, when beneficial rain fell.

The crops, both young plant and young ratoons, were backward, and in very few cases had made cane. One of the most forward blocks was of May-planted Badila belonging to Mr. L. Walker, of Hambledon, which had been thoroughly ploughed many times and afterwards heavily dressed with filter press.

At Hambledon a block of E.K. 28 was inspected—August plant growing upon medium soil and owned by Mr. F. C. Curlewis. About 3 cwt. of mixed manure had been used, and it looked very well, having stooled vigorously and healthily. At Aloomba, Messrs. Carlson and Mann and Mrs. F. Morton have each small plots of this variety, comparing more than favourably with adjoining cane grown under exactly similar conditions.

At Gordonvale a very interesting time was spent with Mr. D. L. McBryde, the mill chemist, in his demonstration-of-diseases plot adjoining the mill. Here may be seen a large number of blanks, representing plants that either did not strike or died out after striking, and in other places healthy plants that had been inoculated with disease by being grown in close proximity to infected plants, and then died out. The plot is a most interesting one and well worth inspecting by every grower.

Grubs.—Very little grub damage was caused this season. Beetles had not, so far, been very numerous, but some "greybacks" were seen at Hambledon.

Mossman.

Crushing had just finished, and the rain came along exactly at the right time. Consequently a good deal of cultivation work was being carried out. There was also a certain amount of late planting going on, and a number of farmers were planting "supplies."

The past season had been a most satisfactory one. The quantity of cane dealt with—75,540 tons—was slightly ahead of the estimate, and the c.c.s. (15.07) was very good.

Mowbray.

Unfortunately this part of the Mossman area did not have as much rain as had recently fallen elsewhere, and consequently the recently-cut cane was backward. Some fair cane was, however, noticed on the farms of Messrs. Hardwick Bros., Robins, and Andreassen.

Diseases.—The district so far has been fairly immune from disease.

Manuring.—The practice of manuring is general.

The following particulars of cane varieties are interesting:—

Variety.	No. of Samples Taken.	Average c.c.s.
D. 1135	1,272	14.52
Badila	1,071	15.68
Clark's Seedling	952	15.78
B. 147	517	14.87
Goru	293	14.81
M.Q. 1 (Mowbray Seedling)	175	14.45
Black Innis	51	14.55
Q. 813	28	15.50
M. 189	26	14.78
B. 156	12	15.36
Malagache	5	14.45
Hybrid No. 1	4	15.80
Q. 903	3	13.30
Rappoe	2	16.84
M. 1900	2	16.41

Of above-mentioned canes, H.Q. 426 (Clark's Seedling), Badila, and Q. 813 show up well, being representative samples taken throughout the season. Rappoe, M. 1900, and Hybrid No. 1 are high, but were only in very small quantities.

Daintree River Area.

This area consists roughly of the Upper Daintree and the Lower Daintree North and South. The land in the Upper Daintree consists of rich alluvial flats upon one side of the river, with very steep spurs running to the water's edge upon the opposite bank. These spurs are heavily covered with either dense tropical scrub or forest. The flats under grass are carrying magnificent crops of *panicum muticum* or other grasses. The cattle seen upon these flats were in splendid condition, and dairymen of experience estimate that this land under artificial grasses will carry some 2½ to 3 beasts to the acre. The day of my visit some 100 head of butchers' cattle were being shifted to the tableland, and were a very good advertisement for the Daintree as a grazing proposition.

On the Lower Daintree there is a far larger and more accessible area that should be suitable for cane-growing, situated upon both the south and north sides of the river. It is mostly covered with thick vines and lawyer cane, and in the few places where landing was available, the soil was very fair and should grow good cane.

Inquiries were made from settlers of from 30 to 40 years' experience upon the river, as to the damage likely to accrue from floods, and it was stated that such water never remained up longer than from 24 to 36 hours, and naturally as the scrub is felled the water will be able to get away much more easily. In his report upon the Daintree lands, Mr. Surveyor Greensill estimates the approximate acreage of cane land as 1,800 acres on the Lower Daintree South, and 1,865 on the Lower Daintree North. One of the south-side settlers has already planted a small area for seed, which probably means the start of cane-growing on a large scale in this particular area.

Babinda.

Since my last visit bountiful rains had fallen. The cane had responded magnificently to the weather conditions. Running water was again to be seen in the creeks, and the pasturage looked a picture. The mill had crushed right through the Christmas holidays, and although the average c.c.s. had fallen, it was still 13.5 for the week ending 29th December, or an average for the whole season of 14.16. Some 20,000 tons of sugar had been manufactured to date, whilst the total quantity of cane harvested for the season was 163,000 tons. Generally the district was very prosperous.

TO PURIFY WATER IN A TANK.

An inquiry was received recently as to the best method of preventing the formation of green slime on well water that had been pumped into an iron tank. "The water is clear and fresh," wrote the correspondent, "and I wash the tank out frequently, but within a few days this green slimy stuff appears, and gets along inside the pipes, causing considerable trouble. Kindly advise if there is any uninjurious chemical, or what method I could adopt, to prevent the growth. The water is used for domestic purposes."

The writer was advised to clean out the tank and cover it so as to exclude the light. Simple aeration of the water in the tank by blowing air into it would tend to prevent the abundant development of the algæ (vegetable growths) with their objectionable tastes and smells. The following methods were suggested for chemical purification and elimination of algæ, &c.:—

1. Bleaching powder, used at the rate of 2 to 2½ ounces per 1,000 gallons of water. The chloride of lime should be mixed in a bucket with water, and the contents added to the water in the tank, and stirred through the mass.
2. Prepare a fairly strong solution of permanganate of potash in water. Add this in small quantities at a time to the water in the tank, stirring well after each addition until the bulk water acquires a very faint pink colour. The final depth of colour may be observed in a tumbler.
3. Copper sulphate (bluestone) is a highly effective algicide, and is extensively used in large water reservoirs, but the amounts used must be very accurately measured. It should be used at the rate of one part bluestone to six million parts water, or 12 grains (actually 11·7 per 1,000 gallons).

In using any of the above methods, two tanks may be employed, in one of which the purification process would be proceeding while the other was being used for any necessary purpose.—A. A. RAMSAY, Chemist.—Ag. Gaz., N.S.W., January.

BREEDS OF PIGS.

E. J. SHELTON, H.D.A., Instructor in Pig Raising.

The first article of this series, "Classification of Pigs," was published in the November Journal. In the December number the points of the Berkshire were set out, and in the last issue the Tamworth breed was fully described. In succeeding issues other breeds of pigs and matters of moment to pig raisers generally will be discussed.—Ed. Q.A.J.

THE MIDDLE YORKSHIRE.

There are several breeds of pigs suited to the climatic conditions and environment of Queensland—the Berkshire, the Tamworth, the Poland-China, the Middle Yorkshire, and the more recently introduced type, the Duroc-Jersey.

There are also, of course, several crossbred types obtained as a result of mating two of these pure breeds together, such as the Tamworth and the Berkshire, &c.

To the young farmer who sets out with the idea of securing foundation stock for his future herd, several important points must therefore be kept in mind. Some of these might be dealt with as follows:—

First, he must consider his own fancy, for most men interested in pig-breeding have a fancy for one breed or another.

Secondly, consideration must be given to the public taste. This is a very important point, as the public represent the buyers, and in order to secure top market rates, we must aim at giving the buyer exactly what he requires.

Thirdly, he should not forget the live stock market demands. Some markets call for one type, some for another. The markets of the South call for a much heavier supply of light and medium weight porkers than the Queensland markets. Their types differ, too; thus in Victoria the most popular types are the Berkshire and the Middle Yorkshire, or a cross between these two breeds. These types being admirably adapted for the production of pork pigs and for the comparatively light bacon pigs, for which there is nowadays such a persistent demand, they suit the Southern markets rather better than the North. It is for this reason that types like the Berkshire, Tamworth, and Poland-China are more popular in Queensland than the famous Old Yorkshire, of which breed we have but one type now, popularly known as the Middle White or the Middle Yorkshire.

ORIGIN OF THE MIDDLE YORKSHIRE.

As far back as the year 1852, Joseph Tuley, a noted breeder of his day, exhibited at the English live stock shows a number of excellent quality white pigs. These were called Large Yorkshires, and were much admired. It was found that they were not altogether satisfactory, however, for they were inclined to grow too large and were, as a result, very coarse; so eventually a smaller type became more popular, and these were known as Small Yorkshires. These, after a wonderful run of popularity, also failed to "fill the bill," and thus it came about that as a result of continued crossing and careful selection another type was fixed, to which the title of Middle Yorkshires, Middle Whites, or Mid-Yorks was given. These have now, particularly in Australia, outgrown both the others in point of popularity with both pork-buyers and bacon-curers. Tuley was in reality one of the founders of this type, and he spent many years striving to make his favourites more perfect, both from a show as well as from a utility standpoint. Thus we have in the Middle York the medium between the short chubby nose and body of the Small Yorkshire and the rather elongated fine snout of the larger type. The short, broad face and the general symmetrical appearance of this breed make them a very attractive as well as a very useful type.

It is usually considered that the short chubby type of pig is much earlier maturing than those carrying a longer, pointed, and less-dished snout, and a more lengthy, fleshy body. This is one of the reasons why the Middle Yorkshire is so very popular as a pork pig. In England the breeders still have the three distinct types of Yorkshires—the Large York (essentially a bacon pig, and for crossing for bacon

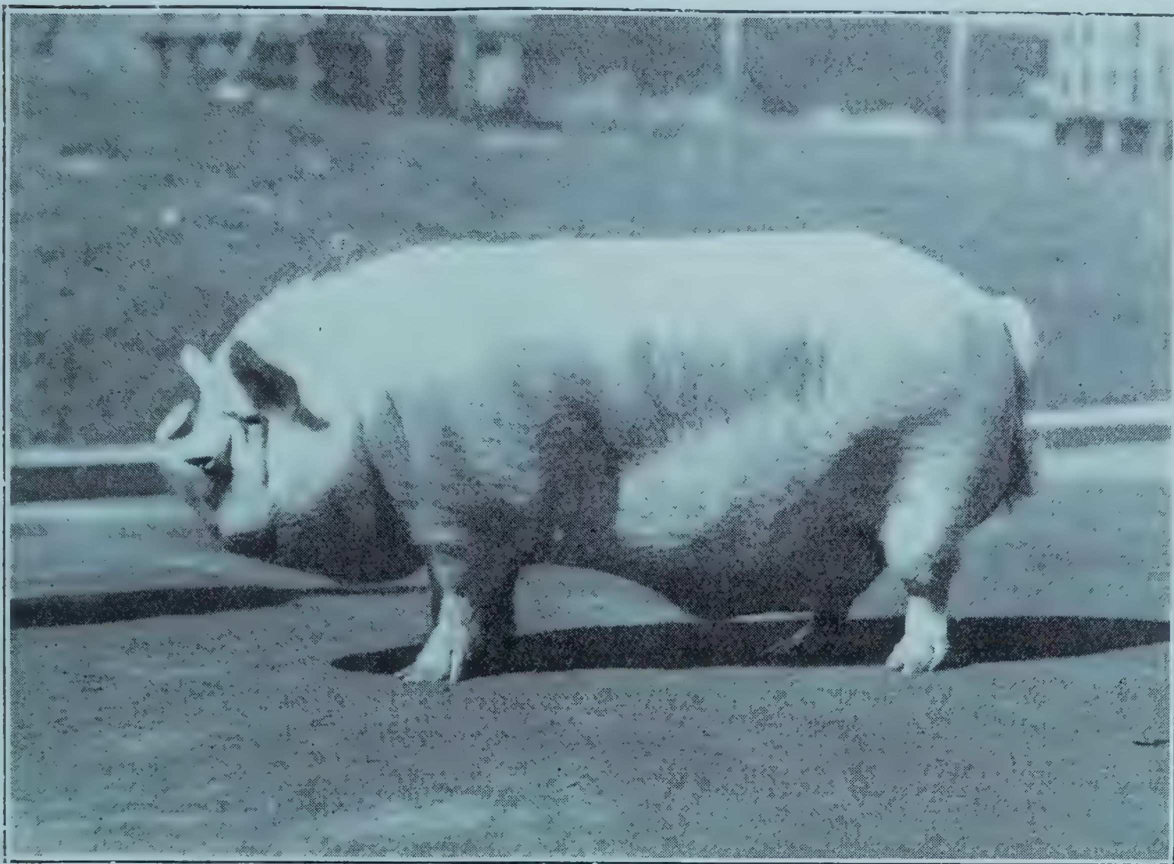


PLATE 11.—RALPH JOYCE'S CHAMPION MIDDLE YORKSHIRE BOAR, "DRAYTON'S CHIEF, 1897."

Winner of Herd-book Ribbons for the Best Yorkshire Boar, Sydney Show, 1923.

PLATE 12.—A CHAMPION MIDDLE YORKSHIRE SOW.

The property of Ralph Joyce, of Kyabram, Victoria.

production), the Middle York (a dual purpose animal suitable for either pork or bacon), and the Small York, which is distinctly a small, fancy trade porker suited only for Christmas or Easter markets. There are no Small Yorkshires in Australia at present; they are distinctly unsuitable for our climate, and we have no demand for the class they represent.

Of Large Yorkshires we have only a few, though this is a type for which there is a certain demand "down South." The Middle Yorkshire we have in very large numbers, and they are also a popular, attractive type, both in Great Britain and in other countries. In the United States of America they are classed as a secondary breed; they do not suit their conditions as well as some of their own white breeds, the Chester White, the Victorias, &c. They have therefore not been taken up very much by our "Yankee" friends, who prefer a "Made in America" breed.

One of the English writers (Harris, on the Pig) says of the Middle Yorks:—"They are perhaps the most useful and most popular of all the white breeds, as they unite in a striking degree the good qualities of the Large and the Small Yorkshires, and fortunately do not possess many of the inferior qualities of either of its progenitors.

"As a bacon pig, the type under review is well developed, and the lengthy sides enable it to produce more lean meat or meat of a 'streaky' nature. For the production of an ideal bacon pig they should be crossed with one of the other breeds, a large breed for preference (this for the English market). For porkers the best results are obtained by mating the Middle Yorkshire sow with the Berkshire or Poland-China boar."

In the pure-bred state the Mid York makes a very useful porker, particularly if well cared for and kept in clean sties or yards and well protected from the sun. They should be well washed and cleaned up before sent in to market if best prices are to be obtained. In the Southern markets they compare more than favourably with the Berkshires, &c. In general they resemble the Berkshire very much; they vie with the latter breed for first place as a medium type but must give way to the Poland-Chinas and Berkshires in districts subject to the extreme heat of summer, as the white pigs are more suited to the temperate parts of the State than to the tropical coastal districts. The Yorkshires cannot stand "sun baking," as their skin is ruined when once badly scalded or sunburnt. As an all-round farm pig for the cooler climates the Middle Yorks are a very fine type, noted for quick growth, early maturity, good feeding qualities, even proportion of fat and lean, with a comparatively light percentage of offal when slaughtered.

Several points worth careful note are as follows:—

(1) They are of a size, shape, and flesh that are desirable for the pork-buyer or bacon-curer's use.

(2) They have a hardy, vigorous constitution and a good coat of hair (if special attention is given to selecting a suitable type), which protects the skin.

(3) They have been spoken of as the gentlest race of pigs in existence, easily handled at all times, and kept in bounds with ordinary fences. They are also quiet and contented.

(4) They feed well and fatten quickly at any age.

(5) They are very prolific. Generally speaking, they are the most prolific and prepotent type we have. The young pigs are mostly even in colour and vary but little in shape. They are true to type and their form, when matured, may be determined by inspecting the sire and dam. They are considerably more prolific than the Small Yorks. Like all white types, they occasionally show blue or very dark spots on their pinkish skin.

Both pork-buyer and bacon-curer agree that the "Yorks," when well fed and cared for, produce a large amount of tasty, nutritious flesh with a minimum of light bone and offal. The flesh is evenly distributed. The sum of good qualities is higher than in most breeds. There is fully 10 per cent. or more difference in the meat value of a good well-developed Yorkshire as against the common pig, of which we have a very large percentage. The latter types are usually deficient in vigour, constitution, and quality of flesh, whilst they are characteristically always hungry and squealing for more food.

SPECIAL ATTENTION IN SELECTING YORKSHIRES.

Special attention should be given in selecting boars and sows of this type in Queensland to ensure securing animals well provided with a thick coat of fine, silky hair, free from coarseness and black hairs. The very soft-skinned light-haired

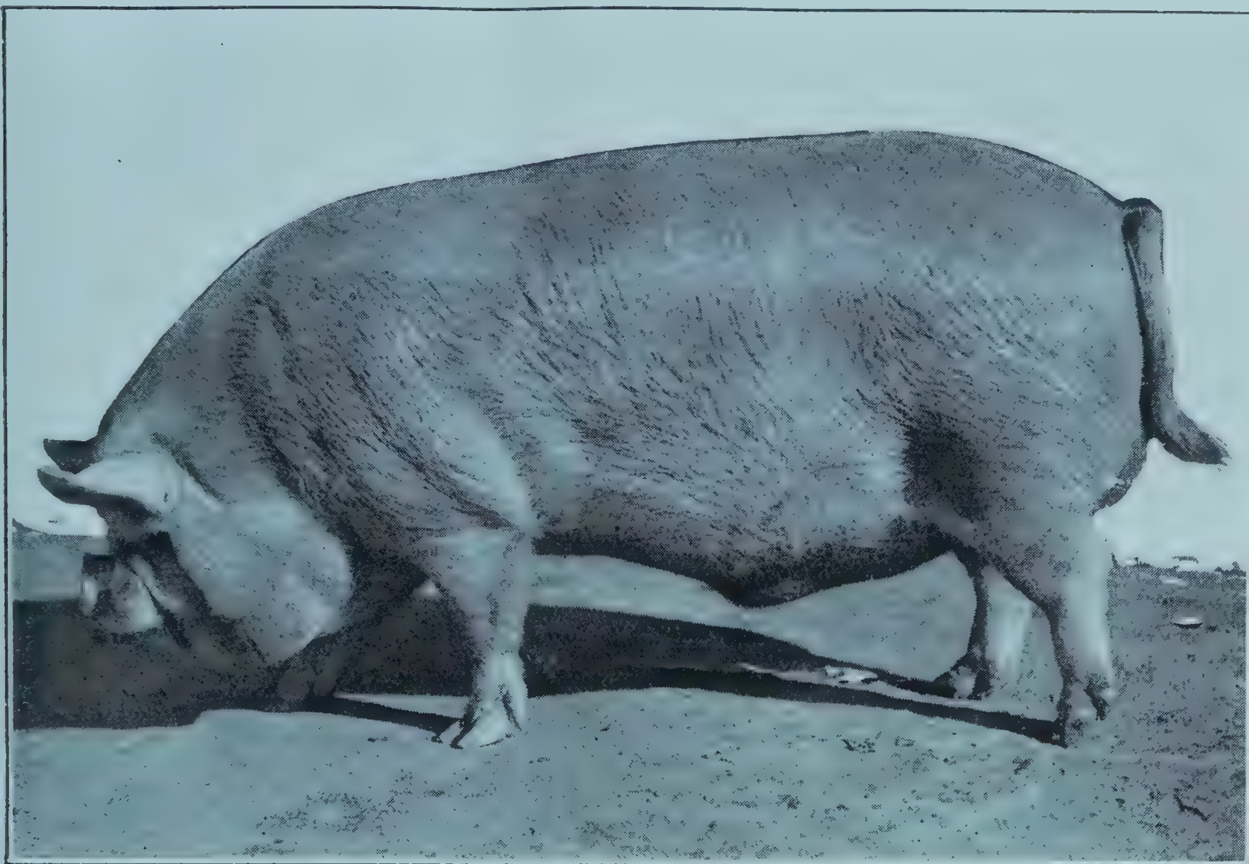


PLATE 13.—A USEFUL QUALITY MIDDLE YORKSHIRE BOAR.
One of W. J. Warburton's Winners, from the Northgate Stud.

PLATE 14.—A TYPICAL MIDDLE YORKSHIRE SOW.
She won First Prize with litter at foot, Sydney Show, 1923. Property of J. Winterbottom, Mascot, New South Wales.

types are quite unsuitable here. See also that they come from types noted for prolificacy. The Yorkshire sow is noted as an excellent mother, giving a good flow of rich milk.

In the Mid York the ham should be more fully developed than in most breeds. It has a great length at the rump, and the tail is usually well set up; the lengthy back, which may be slightly arched, carries a good depth of flesh, and this, connecting with the ham by a strong thick loin, induces a strong development of flesh in this most valuable cut.

OTHER CHARACTERISTICS.

The shoulders should be well set, deep and wide, allowing for the development of a roomy capacious chest, which is a very necessary feature. The neck should taper slightly towards the head. This is particularly noticeable in the female. The jowl is light, running well into the neck. The Yorks do not carry the heavy jowl and short thick neck characteristic of the Poland-China. The snout is short and dished, the muzzle broad and full, ears inclined to be large, though some types have short pricked ears. In the Middle Yorks the legs are usually well developed. This is a weakness in many strains of the larger type. The belly and flanks are deep and full fleshed, and the udders well developed. The sows are prolific, litters ranging from nine to thirteen being by no means uncommon. The "York" boar is usually a very sure stock-getter, and is both active and prepotent.

THE YORKSHIRE'S GREATEST FAULT.

Unfortunately the Yorkshire pigs possess the one great fault—they cannot stand the rougher conditions characteristic of many of our pig farms. They sun scald badly, and do not present the attractive appearance of other types that do not suffer from this defect. There is but one way to overcome this fault. The utmost care should be given in the first instance to selecting thick-haired types, and to providing abundant shade and shelter for the pigs at all times. Given these conditions, with improved methods of feeding and handling, there is no reason why the York should not prove a satisfactory type, though the writer would prefer to recommend the Tamworth, Berkshire, and Poland-Chinas, where fresh stock was being added to any stud.

DEATH OF PIGS FROM SALT OR BRINE POISONING.

E. J. SHELTON, H.D.A., Instructor in Pig Raising.

In the course of a visit to the North Coast districts recently, the writer reported on several outbreaks of disease in pigs.

In one case in particular it was found that the death of a number of pigs was due to their having consumed buttermilk into which an excess of churn washings, containing salt, had been emptied; this especially in cases where very young store pigs were being fed on this ration, and in cases where bacon pigs were in the final fattening stage and were given a full ration of this adulterated buttermilk (with the addition of a small quantity of bran and pollard).

On being analysed, two samples of the buttermilk were reported upon by the Agricultural Chemist, with the following result:—

ANALYSIS OF SAMPLES OF BUTTERMILK AS SUBMITTED.

—	Sample "A" direct from Factory, and containing Buttermilk and Small Percentage of Washings.	Sample "B" from the Piggery where the trouble was experienced, and which evidently contained a heavy Percentage of Churn Washings.
Total solids	1093·4	1992·2
Loss on ignition	730·8	1259·6
Ash	362·6	732·6
Chlorine	134·4	259·0
Equivalent to common salt	221·7	427·3
Heavy metals	Nil	Nil
Arsenic	Nil	Nil

The following extracts have been taken from a special report on the above case by Mr. Veterinary Surgeon J. A. Rudd, of the Department of Agriculture and Stock, who also visited this property :—

> "The analysis of the buttermilk sent to the Agricultural Chemist showed excess of salt. Lately, owing to the scarcity of water, this farmer had been carting the butter washings, which doubtless contain a percentage of salt in excess of the requirements of the pigs, with the result that a number of pigs have succumbed, in all probability as a result of this excess of salt; but there are doubtless other reasons, such as, for instance, overcrowding, at times, in the fattening pen. The carrying capacity of a fattening pen is strictly limited and virtually depends, when room is a factor, on the weather. During the prevailing muggy weather pigs, after gorging on their food, will, if they are all crowded together, die, as the breeder described, very peacefully from heart failure.
>
> "Pigs which are fed on buttermilk should, if purchased outside, be very strong stores. Weaners do not do well on such food as a base for future development, for they naturally suffer in consequence, and any slight ailment is magnified into something serious, this depending, of course, on their condition, whether thrifty or otherwise. . . . .
>
> "I inspected the food tanks in which the buttermilk, &c., was stored, but found them clean. It was suggested that they be covered from the sun and the buttermilk fed as fresh as possible in order to prevent further loss . . ."

This case was one that had caused a good deal of speculation locally, for it had been suggested that the trouble was due to disinfectant solution finding its way into the buttermilk tanks. However, an analysis of the buttermilk proved the source of the trouble. It emphasises the necessity of buttermilk contractors being sure of the quality of this product. It is certain that considerable care is necessary in feeding buttermilk to pigs in order to ensure success. The value of this by-product of the dairy is too great to allow of careless methods of handling and feeding.

QUEENSLAND STOCK IN 1923.

Major A. H. CORY, M.R.C.V.S., Chief Inspector of Stock.

Abstracted from the Annual Report of the Under Secretary for Agriculture and Stock (Mr. Ernest G. E. Scriven) to the Minister (Hon. W. N. Gillies) for presentation to Parliament.

Stock Statistics.

The following figures supplied by the Government Statistician show a decrease on those for the previous year in the number of horses, cattle, and sheep, but an increase in the number of pigs is noted:—

Year.	Horses.	Cattle.	Sheep.	Pigs.
1922	747,543	7,047,370	18,402,399	145,083
1923	714,055	6,955,463	17,641,071	160,617

During the period under review drought conditions have prevailed over the greater portion of the State, the rainfall having been most sparsely distributed, and very patchy in character. The usual summer rainfall was not recorded in the Gulf country, which it is understood is unprecedented. At the latter end of 1922 the pastoral industry was feeling the effects of the drought very seriously, as in many districts no rain fell for the preceding ten months. The general depression in the cattle industry has continued, and cattle have realised very much less per head than was the case two or three years ago and generally are now almost unsaleable. This depression is largely due to the lack of oversea markets and the difficulty in the introduction of fat stock into the Southern States. The State and Federal authorities are now endeavouring to improve the industry by establishing oversea markets, and by generally improving the handling and carriage of meat.

The Marketing Problem.

An Australian Meat Council was formed nearly twelve months ago. Delegates were sent to the East, and their reports show the possibility of fresh markets being opened up. This, in conjunction with a reported shortage of beef and an increased demand in the Southern States, may possibly help the cattle-owners in this State.

Owing to the cattle-tick pest the Southern States impose such stringent regulations on the introduction of our live stock that stockowners are unable to take advantage of the much better Southern markets. It is considered that the three months' period of detention now enforced on our cattle on the Darling Downs or Western country could be considerably reduced even without detriment to the pastoral industry in the Southern States. It is contended that Queensland stock should be allowed introduction into New South Wales after the necessary dippings, in approved medicaments, under supervision, have been carried out in this State. The contention is supported by the fact that cattle from the tick-infested areas of New South Wales are permitted to be travelled to their clean country after dipping and found clean.

Sheep.

The sheep industry has maintained its prosperity, and high prices have been realised for wool and other sheep products. Owing to drought conditions, owners were forced to remove large numbers of sheep from Central Queensland to agistment country north of the Great Northern Railway. The lambing has been extremely irregular, corresponding to the patchy nature of the rainfall. In the Peak Downs and Springsure districts, and in areas west of Roma where rain fell, the lambing was normal, but in many districts there will be practically no increase. The blowfly pest has not been responsible for any serious losses, owing to the unfavourable season.

Stock Experiment Stations.

The Stock Experiment Stations at Yeerongpilly and Townsville have been actively engaged. At the former station 330 specimens were submitted for bacteriological and other examination, 69 stud cattle were made immune against tick fever, 8,910 doses of natural pleuro-pneumonia virus and 1,690 doses of the double blackleg vaccine were distributed in various centres. At the same station the agglutination blood-test was used on 78 suspected cases of contagious abortion, when positive reactions were obtained in 21 cases. Experiments conducted under the auspices of the Federal Institute of Science and Industry in connection with tick dip investigations, and extending over several months, were also carried out.

Work at the Townsville Experiment Station comprised the immunisation against tick fever of 34 head of cattle. Investigations were also conducted into an outbreak of so-called "impaction paralysis of cattle," which was fully reported in the May edition of the "Agricultural Journal." Analyses of dipping fluids and concentrates were made, and viscera and stomach contents examined. Attention is directed to the great enthusiasm displayed by the Inspector of Slaughter-houses, Townsville (Mr. J. A. Rheuben), who in the execution of his duties has, on at least two occasions, discovered parasites that hitherto were unrecorded in Australia.

Departmental Wool Scheme.

The Instructor in Sheep and Wool, in connection with the departmental wool scheme, reports that a larger number of farmers annually are forwarding their clips to the Department, for classification and sale. These small clips are received from all parts of the State. Some owners of wool have been forced to drop out of the scheme owing to the large increase in the number of their flocks, which exceeds the limit provided. Three hundred and sixty-nine bales were sold, comprising about eighty-one thousand pounds of wool. For merinos top price realised 27½d., the lowest price being 5d. for locks. The average price was 20½d. per lb. A new wool-room has been provided, which will be of considerable advantage from an economic aspect in handling the wool. The instructor and his assistant visited various centres and gave instructions to farmers on sheep matters in general.

Analytical Examinations.

Twenty-eight samples of viscera and contents were submitted to the Agricultural Chemist for analysis, and in fourteen cases poison was detected. In North Queensland four samples were examined, of which one contained poison.

Horses Exported.

Two thousand two hundred and ninety-eight horses were exported overseas, of which seven hundred and sixty-five were mares.

Examination of Stallions.

Examinations were held at the following places:—Nambour, Gatton, Rosewood, Brisbane, Sandgate, Laidley, Warwick, Goombungee, Murgon, Kingaroy, Toowoomba, Boonah, Mackay, Toogoolawah, Caboolture, Townsville, Crow's Nest, Beenleigh, Gympie, Clifton, Helidon, Ipswich, and Bundaberg.

Seventy-two stallions were examined, of which number nine, or 12·5 per cent., were rejected.

Dips and Dipping Fluids.

The total number of dips registered in the State is 4,240, as compared with 4,163 last year. Six hundred and forty-eight samples of dipping fluids and twenty-five dip concentrates were analysed. Of these 375 dipping fluids and 23 concentrates were dealt with in Southern and Central Queensland, and 273 dipping fluids and 2 concentrates in North Queensland.

Tick Board.

Owing to the prevailing drought and the poor condition of stock it was found impracticable to provide for regular musters and dippings in the cleansing areas. Straying stock on the various roads and reserves have been a grave menace to the tick-free areas, but the danger has been minimised owing to the fact that ticks have not been as numerous as they would have been under normal weather conditions. Although the regulations provide for at least two dippings and cleanliness of stock for clean areas, it has been found necessary in two cases to dip stock five consecutive times with an interval of seven days between each dipping before the cattle were clean. This is apparently due to the presence of accumulated dust in the base of the hair preventing the liquid gaining access to the skin.

Helidon Cleansing Area.

In consideration of the season the year's work has been very satisfactory. The previous year's figures in respect of inspections and dippings were slightly greater, except in the case of infested holdings, which show a slight decrease. Three infestations occurred in the Withcott area due to straying stock, but no further ticks were found after the first outbreak. The infested properties are quarantined until such time as thorough inspection can be made after rain has fallen. The officer in charge of this area states that large numbers of stock have strayed on to the various roads and reserves. These stock were in such poor condition that they could not be mustered, and the majority have since died, but the opinion has been expressed that they have done no damage to the cleansing area.

Holdings inspected	4,158
Stock inspected	160,704
Stock dipped	33,367
Infested holdings	288

South Burnett Cleansing Area.

Owing to the severity of the drought, extension of this area to include the parishes of Durong and Boondooma was not practicable. Stock in many cases had to be removed within the area for feed and water without enforcing the usual restrictions, but it is not anticipated that adverse consequences will ensue. A few holdings adjoining the tick-infested boundary were reported to be slightly tick-infested, but cannot be dealt with until the stock have regained their normal condition.

Holdings inspected	534
Stock inspected	48,268
Stock dipped	39,383
Infested holdings	73

Miles-Chinchilla Area.

With the exception of four sporadic outbreaks caused by the passage of travelling stock, this area has been free from tick-infestation. A close supervision of stock entering the area has been exercised by departmental officers, particularly on the Great Dividing Range, which forms the northern boundary. If this boundary is thoroughly supervised, and stockowners co-operate in this supervision, there is little likelihood of any serious reinfestments.

Holdings inspected	249
Stock inspected	19,939
Infested holdings	4

Diseases in Stock.

The Veterinary Staff made 370 visits to various centres in Southern and Central Queensland. (Appendix B deals with the work in North Queensland.) Pleuro-pneumonia contagiosa was the principal infectious disease which affected stock in this State during the year, but the number of outbreaks reported were only thirty as compared with seventy during the previous year.

Investigations made revealed the fact that in many cases the diseases were non-infectious.

The following diseases were recorded, viz.:—Tuberculosis, actinomycosis, abortion, influenza, anæmia, dropsy, debility, fungoid poisoning, phosphorus poisoning, arsenical poisoning, lantana and other vegetable poisoning, hoven, impaction, lymphangitis, malignant growths, meningitis, melanosis, neuritis, osteo-malacia, paraphymosis, pleurisy, pneumonia in calves, sterility, scour in calves, tick fever, traumatic pericarditis, urticaria, verminous bronchitis.

Tuberculosis.

During the year under review the tuberculin test was applied to 634 animals, as compared with 381 in 1922 and 280 in 1921. The number of positive reactions was 23, whilst 8 were doubtful, and will be retested.

Of the animals tested 188 were owned by Government departments, 372 privately owned, and 74 were subjected to the test prior to exportation.

Special veterinary attention has been given to the dairy cows in the Brisbane, Maryborough, and Bundaberg districts.

Eighty-nine dairies were visited, 2,791 cows examined, and 21 cows condemned as being diseased.

When cows were destroyed, a post-mortem examination was held in each case, confirming the diagnosis.

It is gratifying to note that the tuberculin test is becoming more popular. Stock-owners must realise sooner or later that it is expensive and unprofitable to retain diseased animals in their herds.

Administration of the Slaughtering Act.

The inspection duties carried out under this Act are steadily increasing. The figures for the year under review show a decided increase in the number of animals slaughtered generally for human consumption. In the metropolitan area alone there are no less than forty-one licensed slaughter-yards, at which, according to figures supplied to the Government Statistician for the year ended the 31st December, 1922, approximately 59,377 cattle, 25,248 calves, 320,860 sheep, and 15,273 pigs were treated.

As previously reported, it is impossible to make a thorough inspection where the number of slaughter-yards is so large, where supervision must be exercised, and until abattoirs are established the inspection must be more or less fragmentary.

The following are the comparative figures, compiled from the returns of the permanent officers of the Department:—

	1921.	1922.
Bullocks	79,268	106,589
Cows	24,848	33,750
Calves	27,018	40,419
Sheep	465,731	461,459
Pigs	21,977	42,549

In addition, returns received from police officers of stock slaughtered for human consumption in 188 centres show the following comparative totals:—

	1921-2.	1922-3.
Bullocks	60,542	63,135
Cows	28,648	31,358
Calves	6,651	5,079
Sheep	110,799	91,577
Pigs	11,082	15,360

In addition to the police supervision in country districts, the senior slaughtering inspector visited the following centres:—Dalby, Charleville, Roma, Toowoomba, Millmerran, Kooroongarra, Cecil Plains, Oakey, Cotton Vale, Thulimba, Stanthorpe, Gatton, Ipswich, Kalbar, Boonah, Toogoolawah, Linville, Rosewood, Lowood, Yarraman. Esk, Dayboro', Palmwoods, Nambour, Boowoogum, Kilkivan, Goomeri, Degilbo, Bundaberg, Gladstone, Rockhampton, Mackay, Finch Hatton, Proserpine, Bowen, Townsville, Ingham, Alpha, Emerald, Southport, Coolangatta. He reports a marked improvement in the general condition of butchers' premises in these districts, although in some instances a very unsatisfactory state of affairs prevailed as a result of the non-observation of sanitary conditions, which rendered necessary the service of an order on the licensee.

In the course of the year seventy new slaughter-houses were erected in various parts of the State: one was remodelled, and two are now under construction; and in conjunction with these slaughter-houses sixty-seven new shops have been established. A total outlay of £20,000 was involved by two individual owners in the erection of three shops and the installation of a refrigerating plant.

It is noted that in the transport of meat the motor is rapidly superseding the horse-drawn vehicle.

A central depôt for the inspection of carcasses of pork and veal has been established at this department. Since its inception in December, 3,912 carcasses of pork and 7,177 carcasses of veal were submitted for inspection.

APPOINTMENT OF COTTON ENTOMOLOGIST.

Commenting on a cable message from London, to the effect that Mr. E. Ballard, of the Bristol University, had been appointed by the Empire Cotton Growing Corporation as Cotton Entomologist to the Commonwealth, the Acting Premier and Secretary for Agriculture and Stock (Hon. W. N. Gillies) stated, in the course of a recent Press interview, that this is the outcome of action taken by him last year. Shortly after the Pan-Pacific Congress, held in Melbourne in August and September, 1923, Mr. Gillies had an interview with Dr. Butler, the distinguished English plant pathologist, who was attending the Congress, and Dr. Butler promised on his return to England to bring the matter of a cotton entomologist for Australia before the Empire Cotton Growing Corporation. This Corporation was established in 1921, and amongst its functions is to assist in the establishment and strengthening of the Agricultural Departments in the Dominions, and to provide facilities for training men in these Departments. At the same time Mr. Gillies cabled and wrote to the Agent-General in London (Hon. J. A. Fihelly), asking him to get in touch with the Empire Cotton Growing Corporation regarding the loan to Australia of a suitable entomologist with a special knowledge of parasites. A cablegram was received from the Agent-General last November, intimating that the Empire Cotton Growing Corporation had decided to appoint an entomologist to its own staff. They anticipated difficulty in finding a suitable man with the knowledge of parasites, but, if successful, the Agent-General intimated that it was reasonably certain that the Corporation would be willing for him to visit Australia to study entomological problems connected with cotton in Queensland and other parts of the Commonwealth. The message from London indicates that the Corporation has now been successful in securing the services of Mr. E. Ballard for a term of four years. He will remain an officer of the Corporation, but his services will be leased to the Commonwealth. A prior cablegram was received by the Director of Cotton Culture (Mr. G. Evans) to a similar effect, and immediately a message, strongly supported by Mr. Gillies, was sent to London recommending that the entomologist should make his headquarters in Queensland.

Mr. Ballard is 34 years of age, and was educated at St. Paul's and Conville and Caius College, Cambridge. He is a B.A. (Natural Science Tripos 1910). He was Government Entomologist for Nyasaland from 1911 to 1913. He then entered the Indian Agricultural Service, and was Government Entomologist in the Madras Presidency from January, 1914, till the present date, with the exception of the period when he was on active service in France and Italy. He was a commissioned officer of the Royal Field Artillery form 1916 to March, 1919.

Amongst published works by Mr. Ballard are: "List of Crop Pests of Nyasaland," "Two Pests of Mahogany in Nyasaland," "The Cotton Aphis," "Mango Hopper Control," "Investigations into the Bionomice of *Platyedra gossypiella* in South India," and many others.

In the course of his service in India he devoted special attention to cotton diseases, particularly to premature bud and boll fall.

ENTOMOLOGICAL NOTES.

JOHN L. FROGGATT, B.Sc., Entomologist.

Following the summer rains, we can expect a rapid growth of plant life. Coincident with this, however, an increase in the numbers of insects, both helpful and pernicious, must be expected. It is not possible to anticipate all the pests that may occur, but a few notes on those which are causing depredations to the crops and which are likely to continue for some time to come may be of help to all concerned.

These notes are compiled from reports by members of the entomological staff of field observations, supplemented in some cases with laboratory notes, and from specimens, &c., sent to the Entomological Branch.

MOTHS.

Cotton Pests.

The Cotton Worm (*Chloridea obsoleta*) is a dull-brown-coloured moth, which varies enormously in markings and colouration. The grub bores into the terminal shoots and bolls, in the first case causing the plant to throw out vegetative branches, and in the latter, devouring the developing lint. Fungus growths often enter through the openings made by the caterpillars and complete the destruction begun by the pest.

The larvæ, on emerging from the eggs, feed on the surface for only a short time, when they burrow into the plant or boll, and pass the remainder of the grub stage enclosed in the plant tissue.

Picking off and destroying bolls showing insect attack and dying terminal shoots will kill many caterpillars, thus reducing the numbers of the following generation of moths.

Several cases of maize having been used very successfully as a trap crop have been recorded. When the plants are in the silking stage, the corn is greatly preferred by this moth to the cotton, the eggs being laid in great numbers on the silks, thus at least reducing the number that can be laid on the cotton plants.

The Spotted Maize Moth (*Dichocrocis punctiferalis*).—This is a small yellow moth with black dots on the wings, arranged more or less symmetrically. The grub of this species causes similar damage to that of the cotton worm. Their larval habits are also similar and control methods must follow the same lines.

Where maize is used as a trap crop in either case, care must be taken to dispose of the plants before the larvæ are full grown, otherwise they will develop into moths right amongst the cotton, and aggravate the infestation it was designed to minimise.

The Rough Boll Worm (*Erias huegeli*).—This is an indigenous moth, the normal habit of the grub of which is to devour the wild hibiscus. It has developed and maintained the habit of infesting the cultivated cotton plants, a close relation of its native host plant. The damage done by this larva is similar to that done by the larvæ of the two previous species.

Destruction of infested bolls and shoots will greatly help to reduce the numbers in the later broods of the moths.

''Standover'' and ratoon cotton, in addition to the native hibiscus plants, need to be very closely watched, as they will form ideal breeding centres to help carry the pest over the non-growing period. The great prolongation of the life cycle, more especially the pupal stage, is of further assistance in this connection. With eggs of this moth laid early in May, 1923, the life cycle was completed in from 79 to 85 days, the egg period occupying 6 to 7 days, the larval period 25 to 27 days, and the pupal period 48 to 51 days. The pupal period in April and May, 1923, extended from 16 to 22 days, while in January, 1924, it only occupied 11 days. It therefore would seem probable that the life cycle in the warmer months of the year does not occupy much, if any, more than three weeks.

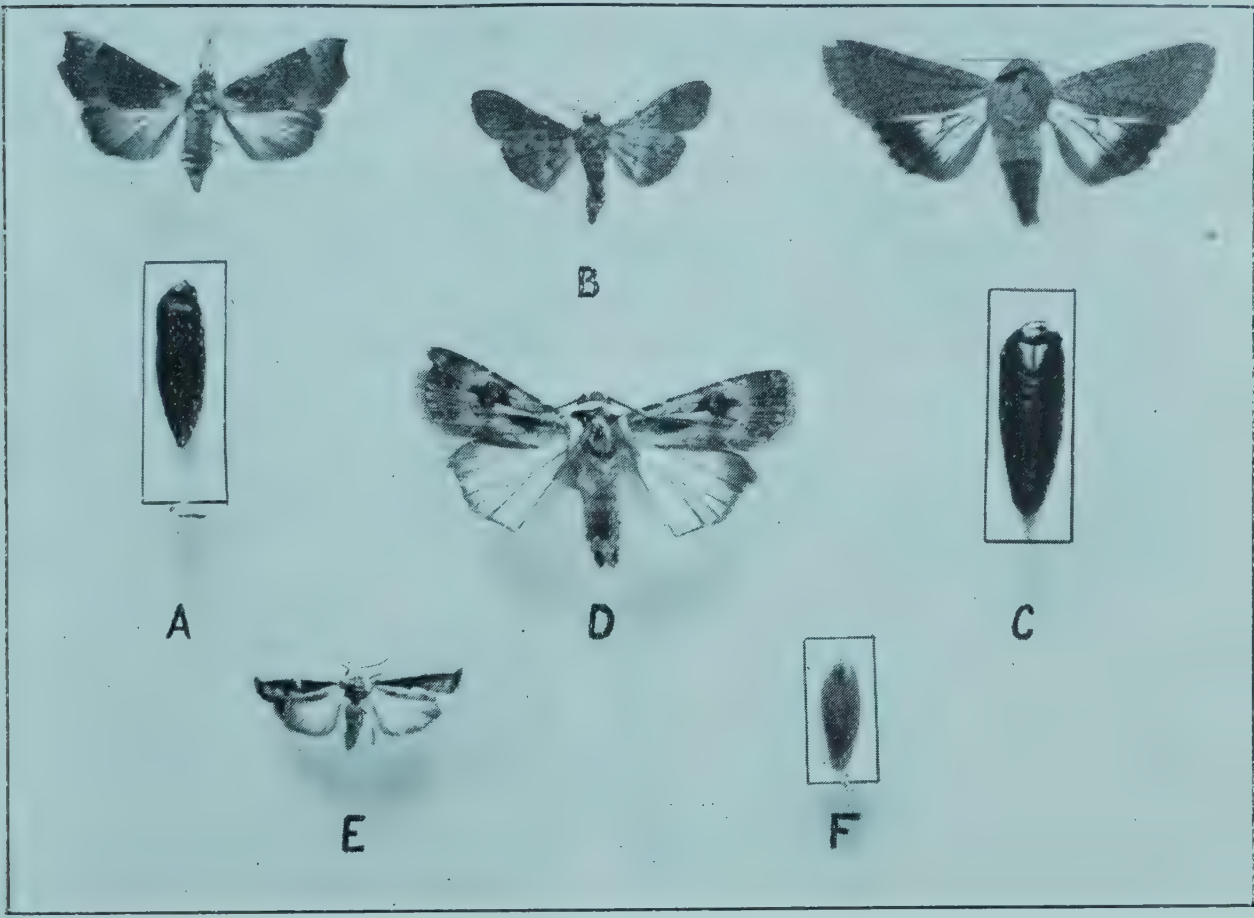
The Brown Cutworm (*Agrotis radians*) and *Neocleptria punctifera* have been associated in causing considerable devastation to young cotton plants.

Mr. F. G. Holdaway, B.Sc., of the Entomological Branch staff, dealt at length with these two Noctuid moths in the January number of this Journal.

Cosmophila xanthindyma.—This is a reddish-coloured moth, the larva of which feeds on the foliage. The larval period of this insect in June, 1923, was 11 to 27 days, and the pupal period 23 to 25 days. The life cycle is apparently about 6 to 7 weeks at that period of the year. One female moth in captivity laid sixty-five eggs.

There is another very tiny moth belonging to the genus *Bucculatrix,* the larva of which in its early stages mines into the tissue of the leaves and may cause a great loss of foliage to the plants.

Leaf-eating caterpillars may be destroyed by an effective dusting or spraying with arsenate of lead. If the former method is used, the poison should be mixed with three parts of finely slacked lime or wood ashes, and be blown over the plant.



THE COTTON MOTHS.

A. *Cosmophila xanthindyna,* Moth and Chrysalis.
B. *Dichocrocis punctiferalis,* Moth.
C. *Chloridea obsoleta,* Moth and Chrysalis.
D. *Agrotis radians,* Moth.
E. *Earias huegeli,* Moth.
F. *Earias huegeli,* Cocoon.
(All natural size.)

PLANT-EATING BEETLES.

Several chrysomelid beetles have been found feeding on cotton, two of which have been very destructive.

1. *The Rose Beetle* (*Monolepta rosea*).—This is a well-known pest of cotton.

2. *Rhyparida australis*—a species new to cotton in Queensland. Observations on this pest will be dealt with at greater length in a separate article by Mr. J. H. Simmonds, B.Sc., of the Entomological Branch staff.

The beetles feed on the foliage, buds, shoots, &c., often causing them to wither and fall off, checking the growth of the plant, and when they are small, often bringing about their complete destruction.

M. rosea was found also to be eating the bracts round young bolls, as a result of which they withered and died.

The native host plants, as also the life histories of these beetles, are not known.

The only methods of control possible are aimed at the destruction of the adult insects as soon as they appear in the crop.

Light flares made by tying pieces of kerosene-soaked bagging on to sticks, which are lit and carried through the infested field at night, attract considerable numbers of the beetles, with the result that they are scorched and die.

Another means that can be used advantageously is to make a shallow tin tray, *e.g.*, by turning up the edges of a sheet of galvanised iron, and fit an attachment on to one or both ends, by which it can be drawn along. It can be made of such a width as to be available for two rows of cotton at once. Pour in water and kerosene, or a light oil. As it is pulled through the field the bushes are shaken over the tray, causing the beetles to fall, when they are caught in the liquid and killed. This is known as the "Hopperdozzer" method.

PLANT BUGS.

Several species of plant bugs are known to frequent cotton, in some cases doing damage of a serious nature.

1. *The Rutherglen Bug* (*Nysius vinitor*) is a small black insect with shiny wings.

2. *The Coon Bug* (*Oxycarenus luctuosus*) is similar to the former species, but has slight black markings on the wings. In the early stages of development it is bright red in colour.

3. *The Chinese Bug* (*Tectacoris banksii*) is a very brightly coloured insect with markings resembling Eastern lettering on its back. It lays its pink eggs in clusters around leaf stalks and twigs on the plants. When the young ones emerge they cling more or less in clusters on the under surface of the leaves for a time. By removing the eggs masses and leaves carrying the young bugs and burning them, very large numbers can be destroyed.

THE CHINESE BUG (*Tectacoris banksii*).

A. Dorsal View of Adult.

B. Female resting on egg mass.

(Natural size.)

4 and 5. The two cotton-stainers (*Dysdercus sidæ* and *Homioceris* sp.) discolour the lint by clambering over the opening bolls and soiling the fibre with their excreta, &c.

The first two species could be destroyed in large numbers by employing the "Hopperdozzer" method in the evening or very early in the morning while the insects are inactive.

All these bugs feed on the sap of the plant, which they obtain by puncturing the bark with their sharp-pointed trunk. Where they are present in numbers, they may often cause the portions attacked to wither and die.

THE COTTON STAINER.

(*Dysdercus sidæ.*)

(Natural size.)

LOCUSTS ("GRASSHOPPERS.")

The common plague locust (*Chortoicetes terminifera*), whenever it occurs in numbers, eats everything green before it. When it attacks cotton while the plants are young, it may cause sufficient destruction to kill them.

The eggs of "grasshoppers" are laid in the ground, and the young, when newly emerged, remain on, or near, the breeding ground for several days before they begin to spread out. In this stage spraying with arsenic solution (1 lb. to 16 gallons of water) will destroy the young hoppers in hordes. Later on the only means is to lay out poison baits composed of bran, green chopped lucerne, &c., wetted with a solution of arsenic of a strength of 4 oz. to 5 gallons. The addition of a little molasses to the poison liquid just before applying it to the bait may render it more attractive to the insects.

TERMITES ("WHITE ANTS.")

These have occasioned slight damage by destroying the roots and boring into the stem of the plant from below ground. Should this damage become serious, treatment of the soil with paradichlorbenzole should tend to keep them away. This chemical would need to be buried in the soil 3 to 4 inches below the surface along the rows close to the base of the plants.

Maize.

Chloridea obsoleta and *Dichocrocis punctiferalis* have been met with on corn, the former rather preferring the cobs and the latter breeding in the cobs, stems, and terminal shoots, and in some cases was far more numerous than the first-mentioned species.

Although this crop has previously only been referred to as a trap crop for *C. obsoleta,* it may prove just as valuable a one for *D. punctiferalis* also.

Tomatoes.

Isodon puncticollis is a small brown beetle, in length slightly greater than in width. It has been destroying the plants by eating the roots.

Treatment of the soil with paradichlorbenzole should keep these insects away.

The tomato moth (*Chloridea obsoleta*) has been already referred to.

Fruit Flies.

The Queensland Fruit Fly (*Chaetodacus tryoni*) and the *Tomato Fly* (*Lonchea splendida*) have both been bred from the fruit.

Chillies.

Fruit Flies.—The Solanum Fly (*Chaetodacus tryoni* var. *solanum*) and *Lonchea splendida* have been bred from chillies. They have completely destroyed the late crop in some localities.

Fig Trees.

The Chrysomelid Beetle (*Galleruca semipullata*) in the larval state has caused considerable damage to the foliage of the trees. Where the fruit is not too near to ripening, a thorough spraying with arsenate of lead or "paris green" should destroy these small black grubs. Otherwise hand-picking and destruction of the infested leaves will have to be resorted to.

A Cerambycid (*Longicorn*) (*Monohammus mixtus*) has been reported to be destroying the young fruit.

Beans.

The Bean Fly (*Agromyza phaseoli*) has been sent in from a number of localities. The eggs are deposited in the plant and the maggots tunnel into the stem and destroy the tissue, causing the plant to wither and die.

No treatment has so far been found to be effective for this pest.

In order that a thorough knowledge of the insect pests may be obtained, it is requested that specimens of all such met with be forwarded to the Entomological Branch, Brisbane, with information on the locality found and damage caused. It is only in this way that most necessary measures can be worked out for preventing devestation by these pests.

THE MAIN ROADS BOARD.

A YEAR'S ACTIVITIES.

In the Second Annual Report of the Main Roads Board there is much valuable material well worth the study of all interested in the vigorous development of the State. The march of the motor vehicle compels greater attention to the facilitation of inland transport and to all that good roads mean to inland dwellers.

It requires no particularly lively imagination to picture the Queensland countryside of the future with its well made and maintained roadways radiating from every town centre—roadways that will not only be feeders to the railways, but also well used traffic lines for horse and motor transport in inter-town and inter-district commerce.

The flow of petrol in ever-increasing volume must have a natural corollary in good roads from the areas of production to the centres of distribution. Motorised delivery has already become a new factor in agricultural progress.

To any community a good road is a new opportunity—a means of improving in many ways the economic and social status of the town and district.

In Queensland in recent years there has been a slow but certain development of roadway construction from a casual activity in the hands of untrained men without programme or plan, other than to maintain a minimum of convenience and facility for ordinary traffic, towards a reasoned industry in the hands of competent engineers, supplemented by intelligent local help. This is part of the forward Government policy of making country life more attractive, and its aim is to provide in rural districts complete and economical traffic service. The Main Roads Board is a medium through which much substantial progress is expected, and the following notes taken from its Second Annual Report, together with plates illustrating its activities, convey an idea of the scope and importance of its work:—

Construction.

Works are commenced after approval of the plans by the Board and Councils, and upon authority being given by the Governor in Council.

In general, the supervision is placed in the hands of the Local Authority, which engages the labour, and if necessary arranges with the Board for the supply of plant.

Frequent inspections of the works are made by the Board's officers, and the Local Authority officers are required to submit cost sheets indicating the progress of works and comparison of actual and estimated costs once a month.

It is regretted that some difficulty has existed in obtaining this very necessary cost data from some Shires, and it is a very noticeable fact that those Shires which have complied with the Board's requests on the matter have carried out their works more cheaply and effectively than those not so doing.

The regular comparison of actual and estimated costs on any work is essential to its economical conclusion, and quickly indicates where improvement in method of working may be possible.

The problem of the economical handling of material, especially in the haulage of metal or gravel, is of the greatest importance and requires close study by the Engineers in charge of the various works.

Broadly speaking, it is more economical to use large drays of from 1¼ to 2 cubic yards capacity for haulage of gravel or metal on leads up to 1 mile. For longer leads, the motor truck or wagon is more economical provided the track is good enough. For still longer leads the traction engine and 5-ton trailers are cheapest, always provided that fuel and suitable water are available, and that the ground is not boggy.

PLATE 15.—BRISBANE-IPSWICH ROAD (NEAR GOODNA).
ate of road when taken over by Main Roads Board. The gap shows site of burned-out bridge.

PLATE 16.—BRISBANE-IPSWICH ROAD (NEAR GOODNA).
Regrading and metalling and replacement of burned-out bridge by fenced embankment and reinforced concrete culvert.

PLATE 17.—REINFORCED CONCRETE CULVERT REPLACING BURNED BRIDGE.
Showing reinforced concrete culvert, 10 feet by 10 feet, at site of burned bridge. The bridg
was 40 feet in length.

PLATE 18.—DARLING DOWNS. ROAD ON BLACK SOIL NEWLY CONSTRUCTED BY SHIRE COU
AT A COST OF ABOUT £15 PER CHAIN.

PLATE 19.—DARLING DOWNS.

Same road, indicating the necessity for bringing about "Weight of Load Regulations," and the absolute waste in constructing roads of inferior material and insufficient thickness to carry heavy traffic in black soil.

PLATE 20.—COOROY-TEWANTIN ROAD.

Showing completed gravelling.

The transportation of crushed stone from fixed quarries either direct to the road bed or to railway trucks is most cheaply effected by light tramways and side-tipping trucks, provided that the quantity of metal to be supplied from the fixed plant is large enough to keep the equipment charges per cubic yard of metal at a low figure. The tramway may often be arranged so that the trucks run by gravity to the dumping point and are hauled back by a light petrol locomotive. The ingenuity of Engineer Kennedy, acting on behalf of the Shire Engineer for Landsborough (Mr. A. E. Harding Frew, B.E.) has solved the problem of using motor bicycle engines of up to 8 h.p. mounted on truck frames for this purpose.

The problem of the foundation or lower course of a road with a macadam top course requires very careful study. In general, gravels, sandstones, or ironstones may be obtained locally and may be hand broken and rolled solid much more cheaply than the hard crushed stone which is to form the top course, yet it has been observed by the Board on occasion that merely for the purpose of keeping a crushing plant going, expensive crushed stone has been used for this purpose when the extra money involved could have been much more usefully employed in extending the mileage of work.

After careful consideration of the standards laid down in the First Annual Report for thickness, width and classes of materials required in the construction of macadam and gravel roads, and taking into consideration traffic, climatic, and soil conditions, the Board is unhesitatingly of opinion that any reduction in standard thickness would be most unwise.

Roads on the Downs.

The fact that heavily trafficked roads on the bad black soil foundation of the Darling Downs cost, when built to the Board's standards, as much as £5,460 per mile for 16 feet of macadam and for 12 feet £3,140, has been used as an argument for the construction of an inferior road, but the Board has direct evidence that such an inferior road, costing from £15 to £18 per chain or £1,200 per mile, has been practically destroyed within eighteen months of its construction, as the accompanying photographs will show. The asset value at the end of two years is certainly not more than £400 per mile, or a total loss of £400 per annum per mile, and all this with a most inferior road available for traffic.

Now £400 per annum would provide funds to the Local Authority for the construction of a road costing £11,430 per mile under the Main Roads Act, or more than double the heaviest actual cost per mile incurred on the Downs.

Mountain Roads.

In the case of mountain roads carrying a large volume of heavy traffic, it is essential both that the grade shall be easy and the surface smooth, hard, and thick enough to prevent heavily-loaded wheels from breaking through.

The Landsborough-Maleny road is a case in point. The old road gradients were about 1 in 8 and the surface so deeply rutted as to be almost impassable after rain. The new road under construction has no grade steeper than 1 in 18, and generally much easier. The new location is everywhere no further from the old than a quarter of a mile. It is properly drained and metalled to a minimum width of 12 feet (widened to 15 feet on the inside of curves which are super-elevated). The foundation consists of consolidated thickness of 6 inches of local sandstone which has set like a concrete. This is capped by a wearing surface having a consolidated thickness of 6-inches of crushed basalt bound with screenings and stone dust.

A road built on a steeper gradient would be most expensive to maintain, and if a lesser thickness of road crust had been adopted would, owing to the poor subgrade condition, quickly break through and be destroyed.

The old so-called road has been costing the Council £1,600 per annum for maintaining in its present awful condition.

PLATE 21.—FIRST SECTION OF THE ATHERTON TO YUNGABURRA ROAD.

PLATE 22.—CAIRNS TABLELAND ROAD, LITTLE MULGRAVE SECTION.

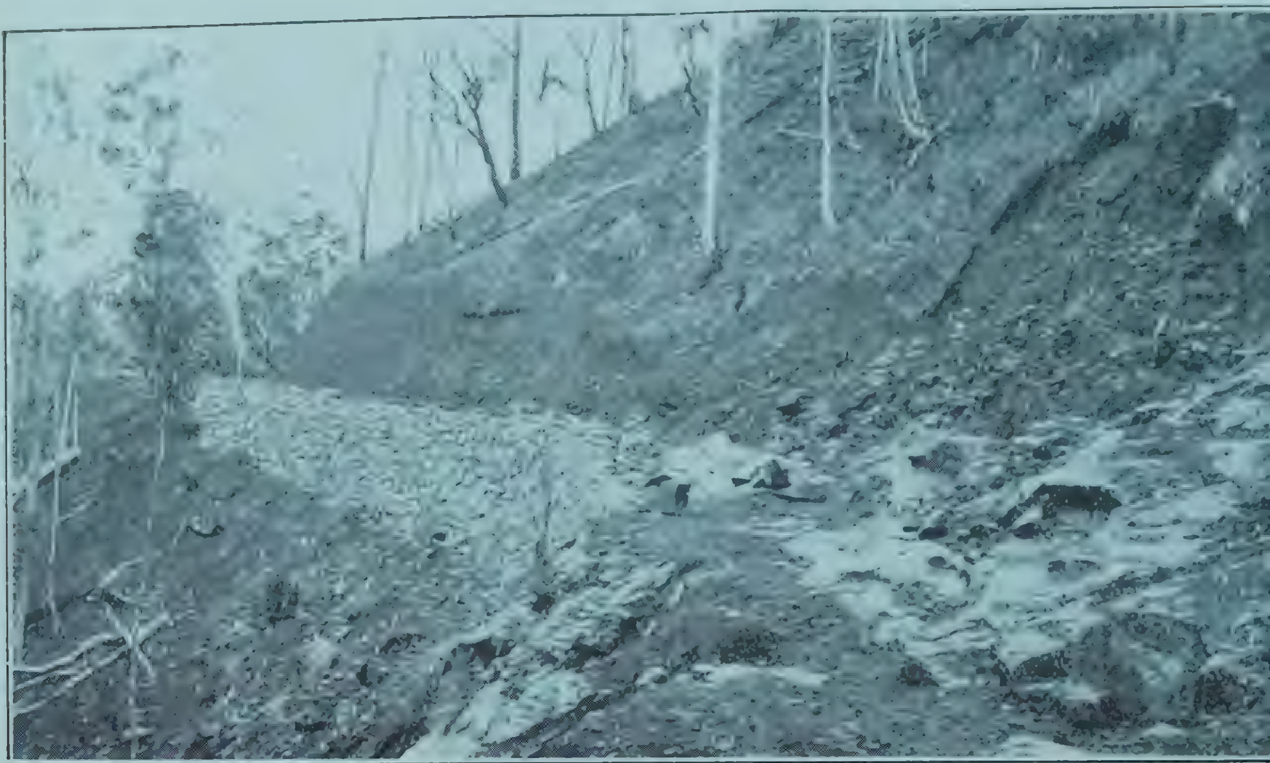


PLATE 23.—TAMBOURINE MOUNTAIN ROAD, ROCK WALLING.

PLATE 24.—LANDSBOROUGH-MALENY ROAD, SHOWING COMPLETED METALLING.

PLATE 25.—SECTION OF COMMONWEALTH GRANT WORK.

PLATE 26.—RIDGELANDS-YAAMBA ROAD.

If we assume that £1,400 of this amount be earmarked for repayment of interest and redemption, then the first £40,000 expended on the new road will be provided for and the maintenance can be dealt with by the expenditure of £200 per annum by the Council and £200 by the Board without the road costing the ratepayers one shilling more than they are paying for the present imitation of a road.

The two cases quoted have been chosen as they represent instances of roads of heaviest cost.

Low Cost Construction.

As an instance of low cost it may be stated that excellent gravelling work has been carried out on the Southport road, in Coomera and Beenleigh Shires, at a minimum cost per mile of £230, and an average of £450. The gravel in this instance was obtained locally on short leads and hauled in a steam wagon, motor trucks, or horse-drawn vehicles, and was watered before rolling with a steam wagon, the front wheels of which were removed and a roller substituted for the purpose. A profile board and spirit level were used to ensure that the shape of the road was correctly maintained.

A much better road has been constructed than it was possible for the Local Authorities under the old conditions to build at anything approaching the same cost.

A Californian Comparison.

The seventh biennial report of the Californian State Highway Commission of December, 1920, page 111, indicates that the average cost of a mountain road (earthwork and retaining walls only) in Mendocino County, constructed by convict labour, was 16,271 dollars per mile, exclusive of bridges, notwithstanding that machine drills and steam shovels were freely used. On page 139 of the same report the following are costs of grading taken at random:—

	Miles.	Dollars.
Humbold County	4·95	12,998
	6·86	71,668
Imperial County	5·84	43,686
Los Angeles	12·84	146,922
	1·04	3,506
Siskiyou	4·50	42,632
	36·03	321,412

Indicating that 36·03 miles cost 321,412 dollars; or an average cost of £2,051 per mile for grading only, prior to surfacing with gravel, concrete, or macadam.

This is the best possible evidence that other countries will not tolerate inferior road work even though the cost of good work be high.

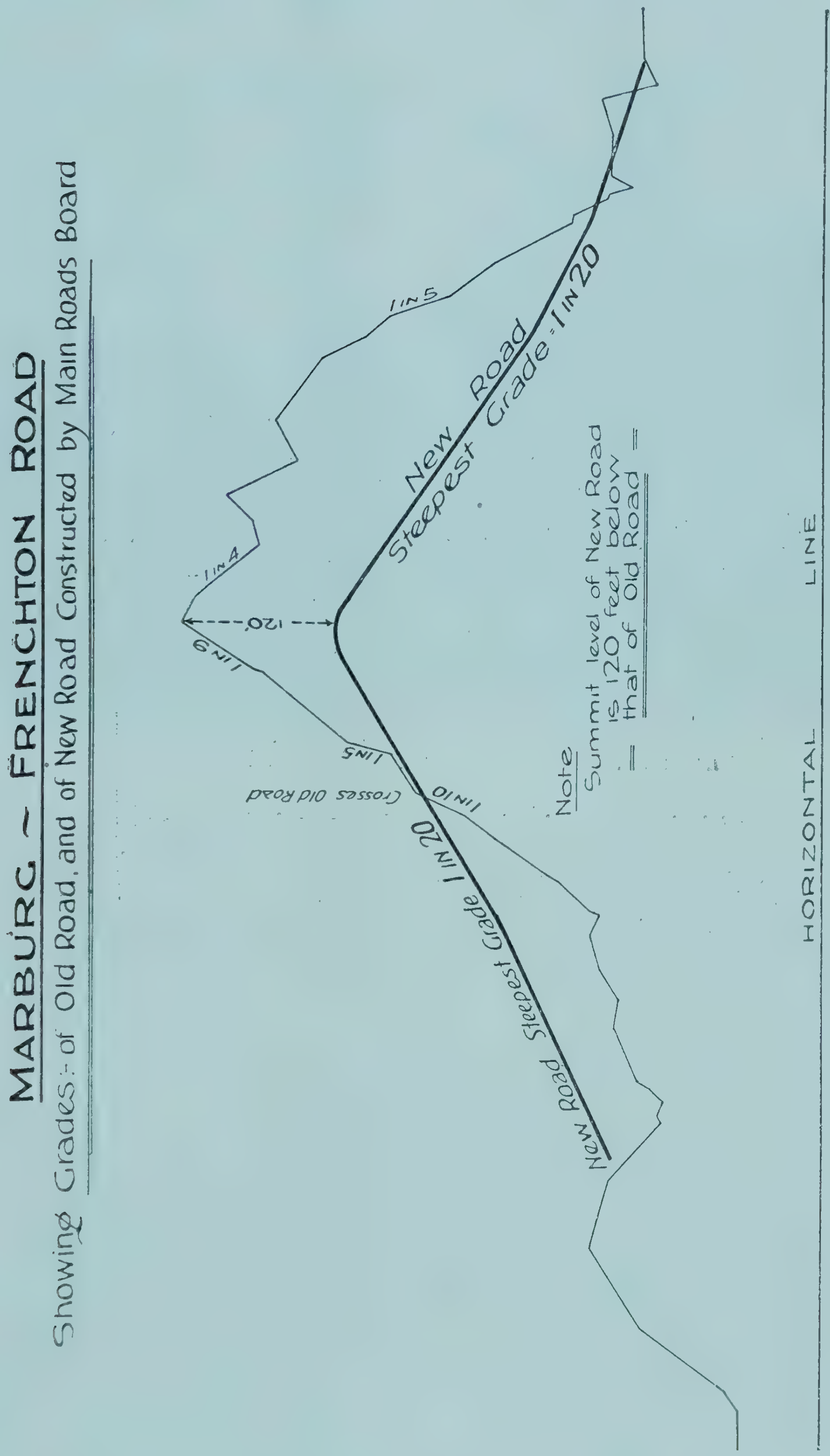
Surface Treatment.

Certain main roads which carry, or will carry, a large proportion of motor traffic, require special surface treatment in order to prevent unravelling of the macadam. In general, only a surface spraying with distilled tar or bitumen, covered lightly with coarse sand, gravel, or stone screenings, will be necessary in these cases.

One section of the Ipswich road, near Goodna, has been so treated with excellent results and it is proposed to so protect the surface of the work in progress between Bullock Head Creek and the railway crossing overbridge at Dingo Hill, on the boundary of Moreton and Sherwood Shires. The Anzac Memorial road now under construction between Petrie and Redcliffe will be protected in a similar manner.

A comparison between the original Marburg-Frenchton road and that recently completed by the Board is illustrated. Grades have been very greatly improved—the steepest on the old road being 1 in 4, while the new road has no grade steeper than 1 in 20. This means a reduction in haulage cost per mile in the ratio of 2 is to 7, and is an illustration of the value of scientific location.

In addition, the new road crosses the range at a point 120 feet lower than the old, and on this account alone there will be a saving of at least half a million foot tons of energy per annum—that is, the energy required to lift 500,000 through a height of 1 foot.



It is necessary to correct the impression which has gained ground that when a road is gazetted the Board will proceed to macadamise it throughout.

Gravelling or macadamising is only undertaken where necessary, and many sections of road will be merely cleared and drained, whilst other sections may only be lightly formed with the local material.

Special care is being taken to ensure that wherever possible existing road foundation shall be incorporated as part of necessary new work.

The Board has noted with considerable satisfaction that a number of Shire Councils in their endeavour to economically and effectively handle Main Roads works have employed either permanent or consulting engineers, and the results in most cases have been very beneficial.

PLATE 27.—MAINTENANCE WORK ON A MOUNTAIN ROAD.

The Board is in communication with the Commissioner for Railways in order to avoid unnecessary competition between Main Roads and railways. It is the Board's policy not to recommend the declaration of any road as a Main Road which would be likely to interfere with railway traffic earnings. In the cases, however, of the Brisbane-Ipswich road, and the Cairns-Tableland road, there are special circumstances existing; in the former case the road is an inter-communication route, between two large cities, and in the latter between a large producing area at an elevation of 2,500 feet, and its port of shipment at present having no road communication with the coast.

TOMATO MOTH.

The caterpillar of the Tomato Moth frequently causes very serious loss to tomato-growers in different parts of the State. It is always present in one part or another of the tomato-growing districts of Queensland, and unfortunately it is a somewhat omniverous feeder, attacking cotton, maize, peas, beans, potatoes, tobacco, and other plants. Mr. Benson therefore recommends all tomato-growers and others whose crops suffer from the ravages of this pest to take the following precautionary control measures:—Dealing especially with tomatoes, this pest lays its eggs on various parts of the plant, and the caterpillars when first hatched feed on the leaves, flowers, or the young shoots, or they may burrow directly into the fruit. Spraying the plants with a mixture of Bordeaux mixture and arsenate of lead, using 3 to 4 lb. of the latter to 100 gallons of the bordeaux mixture, will be found an effectual remedy if applied as soon as the young caterpillars are hatched out, as they will probably consume a portion of the poison and thus be destroyed. In addition to the spraying, all fruit that shows any trace of moth should be gathered and boiled, for, if allowed to lie about on the ground, it only increases the number of moths. Where a crop is very badly infested it is desirable to destroy both the haulms and fruit and to break up the land, as by doing so most of the pupæ that are in the ground will be destroyed.—A. H. BENSON, M.R.A.C., Director of Fruit Culture.

THE PINEAPPLE INDUSTRY OF HAWAII.

By Major DANIEL E. EVANS, D.S.O., M.I.E.S., M.I.M.E.

The following notes by Major Evans, who is well known in Brisbane business and professional circles, were made in the course of a recent visit to the Hawaiian Islands, and will be read with much interest by Queensland pineapple-growers. They cover experimental activities, methods of cultivation, and economical treatment of the product ; also, the manufacture of by-products and the use of paper of local manufacture for mulching purposes.—Ed.

I was much impressed with the large production of the pineapple in the Hawaiian Islands and the care taken in the selection of seed plants and cultivation. Last season 6,000,000 cases of canned pineapples were exported from the Islands. As may be expected, considerable experimental work was necessary to work up such a large industry. Until recently, the pineapple experiment station existed as a department of the Hawaiian Sugar Planters' Association experiment station, but it was found that this relationship was inadequate, and a decision was made to acquire a piece of land and go more extensively into experimental work with pineapples.

The separation of the pineapple experiment station from the sugar experiment station took place at the beginning of 1923, and it was about this time that work was begun on the new station at Wahiawa, and as soon as the plant had progressed far enough the pineapple people moved into their new quarters.

The station consists of one office building, three glass houses, one lath house, one combined warehouse, store-room and implement shed, one stable, three houses for labourers, and two residences for members of the staff.

All buildings are one story wooden structures, and, with the exception of the two residences, all are painted dark green with white trimmings. The residences are painted dark red, with light red trimmings.

The largest of these buildings is the lath house, which is about 50 feet by 110 feet. This building is said to be already too small, and it is planned to enlarge it next year.

The glass houses are each 18 feet by 40 feet. At present the station has 60 acres of land, half of which is being planted this year. The rest will be planted next year. In 1925 another 40 acres of land will be available, making a grand total of 100 acres.

The Cayenne Variety.

The head of the experiment station is said to have stated that the Cayenne is the best commercial variety of pineapple. The Cayenne pineapple was first grown in the hot houses of England, where it was tended with the greatest of care. It is said to be produced commercially in only a few parts of the world, Hawaii being the most outstanding. The station staff are of the opinion that better strains of this variety may be selected and developed, but a better variety can not be had.

It has been observed that some pineapples use up much of their strength in throwing sprouts, while others throw a very fine commercial fruit. Naturally the former has higher propagation powers, and in late years has been multiplying more rapidly than the others; but as commercial fruit is that required, efforts carefully directed are being made to weed out the less desirable type and replace with a heavy fruiting strain.

Great care is used in handling the seedlings. They are first planted in covered moist chambers on cardboard, which rests on inverted saucers surrounded by water. Here they germinate and start little shoots and leaves. Later they are transplanted to soil, and are placed in the glass greenhouses, from which they are eventually transplanted to the lath house, and finally to the field where they are exposed to the full sunlight. When first removed from the lath house the plants are still in their containers, and on being accustomed to their new surroundings they are removed from the containers and placed in the field.

In the glass houses the young plants have a tempered sunlight and are fully protected from the weather.

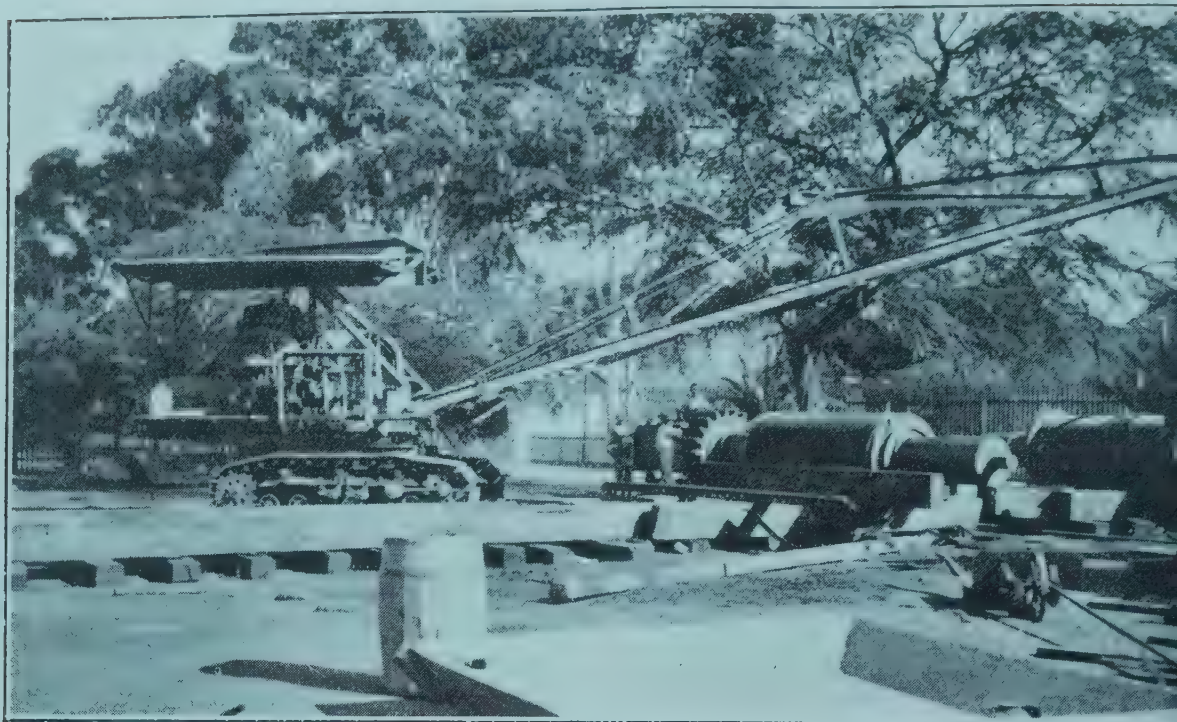


PLATE 28.—PINEAPPLE INDUSTRY, HAWAII.
A portable Field Cane Loader, worked on the block system, Hawaii.

PLATE 29.—PORTION OF ONE OF THE LARGEST PUMPING STATIONS IN THE WORLD, IN THE HILLS OF OAHU.
This station, No. 4, lifts 42,000,000 gallons per diem. The plants of the controlling company pump, in the aggregate, 110,000,000 gallons every 24 hours.

PLATE 30.—PINEAPPLE LANDS ON OAHU, HAWAIIAN ISLANDS.

PLATE 31.—AN HAWAIIAN PINEAPPLE FIELD.
Showing paper mulch strips laid ready for planting.

The lath house exposes the plants to half sunlight and partially protects them from the weather.

In these buildings every stage, from seedling to mature plant, is specially cared for. In normal field practice the tops or some other hardy part of the plant is used, and it is not necessary to take so many precautions against the sun or weather.

Quarantine.

Strict quarantine exists to protect the Cayenne and other varieties from insects that thrive in other parts of the world. Should the experiment station require to bring a new variety into the Islands, it could do so only in a very round-about way. The plant would need to be kept in quarantine in Washington for a year or more, and then it, or one of its descendants, would be sent to the Islands, there again to be kept in quarantine for another long period, so that it would require a few years to introduce a new variety.

Labour-saving Machinery.

The development of labour-saving machinery is most marked. A combination subsoiler and plough and a paper-laying machine are two important achievements in this direction.

The subsoiler and plough, which is drawn by mules, drops to the subsoil and then ploughs the ground.

The paper-laying machine is made in the form of a sled, which carries the paper roll. The machine is drawn by mules or tractor, and smooths the furrows as it moves along and lays the paper; an attachment behind the paper roll crowns the edges of the paper to keep it down.

Manufacture of the Paper.

Most sugar mills in the Hawaiian Islands have considerable excess of megass (cane fibre) than is required for fuel for crushing and manufacturing. This is used in a variety of ways—fuel in factory during the slack season, fuel for irrigation power stations; while the Olaa Sugar Company's factory on the island of Hawaii convert their surplus megass into paper for use in the planting of sugar-cane and pineapples. This sugar factory, when crushing 60 tons of cane per hour, averages 25 to 30 tons of surplus megass in 24 hours, which all goes through the paper mill. Samples of this paper were collected.

PINEAPPLE CANNING.

I had the opportunity of inspecting the Queensland State Cannery when they installed modern pineapple machinery in the form of Ginaco machines about the end of 1918, and I was naturally interested to see the development since that date. I visited the Baldwin Packing Company's cannery at Lahnia, on the island of Mani, and the Californian Packing Company, Honolulu. Both these canneries are fitted with Ginaco machines. The latter place has nineteen on one floor with an output of approximately 2,500,000 cases of canned pines per year. Many improvements have been made on the machinery as installed at the State Cannery, and these could be easily fitted if royalties on patents can be arranged.

System of Handling.

The pines are taken from cases at landing stages and placed on the Ginaco machine conveyor. The conveyor elevates the pines to the machine, where they are skinned and cored in one operation, and then fall on a travelling rubber belt. Any pines that need trimming on the ends, due to any peculiar shape of the fruit, are touched up on a special cutter running at a speed of 1,800 revolutions per minute (this machine has been responsible for saving at least two hands per machine), and further hand trimming is attended to while travelling along to the slicing machine. After slicing, the fruit travels along a ribbed rubber belt. The ribbing allows of the pine slices being easily lifted for placing in the tins.

Pineapple Crush.

This is the term agreed upon by canners for broken slices and good whole pieces of pineapple. These large pieces of broken pineapple are put through a mincer, canned, and treated separately, and is largely used for salads, pies, &c. Supply is only about 75 per cent. of the demand for this product.

Pineapple Jam.

Jam is made from the pineapple fruit scraped from the skins in a machine called a skin eradicator. In the installation, as arranged, by the California Packing Company, the skins are automatically fed into the Fisher Patent Eradicator with the Opperman Patent attachment. After the fruit is separated from the skin the fruit passes along the conveyor to brass jam pumps, and thence to boiling pots. The skins pass to the conveyor on to grinding mill.

PLATE 32.—PAPER MULCH IN USE ON HAWAIIAN PINE LANDS.

PLATE 33.—PLANTING PINEAPPLES THROUGH PAPER MULCH, HAWAIIAN ISLANDS. The paper is manufactured locally from megass.

Treatment of Skins and Manufacture of Syrup.

The skins are then treated in a similar manner to sugar-cane. Methods differ slightly in various factories, but the ultimate objective is the same—the conservation of all juice and the manufacture of syrup.

The skins are passed through shredders, rollers, or, in the case of the Baldwin Packing Company, a worm press similar to a grape-press.

The extracted juice is then pumped to liming tanks and neutralizer. After treatment by liming it is pumped to a heater and elevated storage tanks. Clarification and filtration, similar to sugar-mill practice, is carried out, and finally the pineapple juice, in the form of a golden fluid, is run into storage tanks for supply to pineapple being canned.

One gallon of juice treated as above is equal to 1 lb. of sugar, and it is claimed that the pineapple takes a better colour and flavour than when treated with ordinary sugar syrup.

Evaporation of the Juice.

Some of the canneries evaporate a certain amount of water from the juice, while others claim the evaporated syrup darkens the pineapple, while the original clarified juice gives the true golden colour.

PLATE 34.—AN IRRIGATION CHANNEL, LAID THROUGH PINE LANDS TO IRRIGATE CANEFIELDS FURTHER ON, OAHU, HAWAIIAN ISLANDS.

The water supply is obtained by tunnelling into the mountains to spring sources.

The Future of the Industry.

Big projects are in hand for extending the industry and increasing supplies. Included in the lands of Upper Hoolehua and Palaau, connected with the proposed Waihanau water development project, are some 4,000 acres of the best pineapple land in the territory, and conferences between the Hawaiian Homes Commission and local pineapple people brought out the fact that a settler, assisted by his wife and three or four children, can take care of approximately 30 acres of pineapples after the land has been ploughed and the fruit planted. The only outside assistance they will need, according to the *Honolulu Star—Bulletin*, will be at harvesting time. Provided the settler is successful, he can clear 1,000 dollars an acre in a four-year period, or 30,000 dollars from 30 acres in four years, or 7,500 dollars a year.

If it is decided finally to introduce pineapple cultivation, and if the commission is convinced that one family can care for 30 acres, arrangements will be made whereby this size of tract may be allotted to a single family.

The opening of the lands of Hoolehua and Palaau will constitute the second unit of the Hawaiian rehabilitation project. The first unit is now established on the lands of lower Kalamaula, near the port of Kaunakakai, and is known as Kalanianaole Settlement, being named after the late Prince-Delegate Jonah Kuhio Kalanianaole, who fathered the rehabilitation project.

PLATE 35.—PLANT CANE ON OAHU (HAWAIIAN ISLANDS).
Note irrigation pipe line in the distance. The pipes are of steel, 6 ft. in diameter.

IRRIGATION IN QUEENSLAND—VIII.

H. E. A. EKLUND, late Hydraulic Engineer, Queensland Water Supply Department.

The first of this series, a historical note, was published in the July Journal. Irrigation in the Lower Burdekin was reviewed in the August number, and the instalment in the following issue covered Irrigation in the West. In the October Journal practical considerations were discussed, the November number contained notes on Surface Supplies, and the following instalment covered notes on the Duty of Water and the preparation of lands for irrigation. In the last issue systems of irrigation were described. Subjoined is the concluding article of the series. In the next issue the tables referred to from time to time in the text will be published.—Ed.

SPRAY SYSTEMS.

Spray systems, hardly ever considered until comparatively recently, are now much favoured by irrigators. When they first made their appearance it was claimed and thought that here was the solution of all difficulties in connection with grading and subsequent labour of applying water. Control seemed well-nigh perfect, and though some imperfections were known to exist, these were considered as good as overcome. Subsequent experience has shown, however, that spray systems are not the universal panacea they were thought to be, but rather that they have their own special field in irrigation. In this, even, they require to be manipulated with some skill and experience, to give efficient and satisfactory service.

All spray systems attempt, more or less successfully, to apply the water to the soil in imitation of rain, and so at least secure the greatest aeration possible. To achieve the object water is transmitted to the crop to be irrigated in pipes—under pressure. In this all spray systems are alike, but the mechanical appliances used in the attempt to secure an even distribution differ more or less.

A very great number of advantages of spray systems over ordinary methods of irrigation have been claimed, but it will be sufficient to here mention a few that do not appear to have been disputed:—

1. Minimum amount of waste.
2. Some preparatory work obviated.
3. Aeration improves the quality and, therefore, the value of the water used.

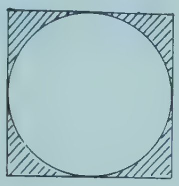
It may be contentious ground to state that spray systems have disadvantages as well as advantages. As a matter of fact, at a modest estimate there are three spray systems for every known method of distributing or applying water by gravity. Inventions are still being made and perfected, the reason presumably being that there is room for improvement.

Spray systems are, broadly speaking, of two kinds:—Those which effect the distribution by a series of circles radiating from a central standpipe provided with a special rose, nozzle, or revolving arms; and those which accomplish the desired effect by the parallel motion of a pipe over the ground to be watered. The former kind are termed radial sprays; the latter overhead or parallel.

Theoretically the most apparent disadvantage of at least the radial spray is that, as circles will not fit together, the irrigator must choose whether he prefers to have some of the ground watered twice or not at all. In actual practice the effect is neither as good over the watered area nor as bad over the supposedly unwatered portion as a paper survey would lead one to suppose.

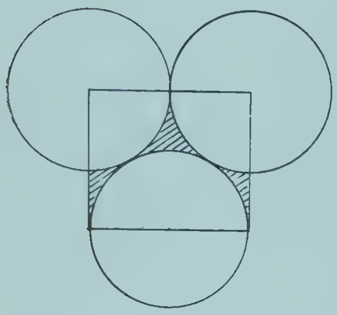
It will, however, be of interest to glance at the diagrams given in the following figures:—

1. By placing the standards in the middle of a square, the corners would get a minimum of water, as shown in Fig. 53. The area thus left unwatered is approximately 21 per cent. of the square.
2. An obviously better arrangement is to place the standards at the corners of equal sided triangles. The theoretical area thus left unwatered is only about 9.3 per cent., and if the rest of the distribution can be shown to be even, seepage and the capillary action of the soil can be trusted to take care of this small amount of irregularity. (Fig. 54.)



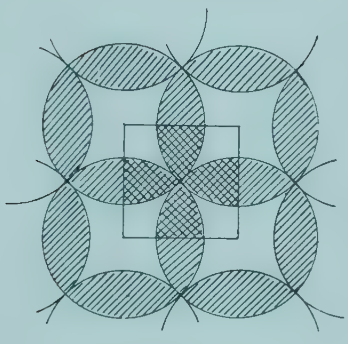
Area of Square 100·00 Sq ft
" Circle 78 54 " "
Balance unwatered. 21 46 " "
or 21 %

Fig. 53



Area of Rectangle 86·60 Sq ft
" " contained Sectors } 78 54 " "
Balance of Area unwatered } 8 06 " "
Say 9·3 %

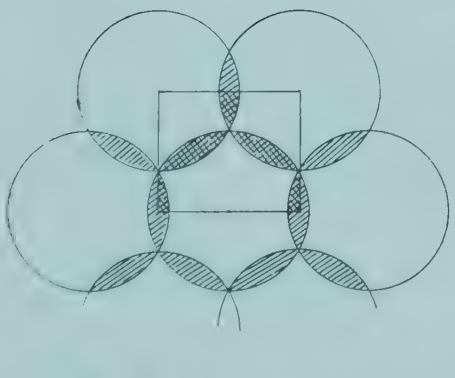
Fig 54



Area of Rectangle 49 99 Sq ft
Area of Portion watered twice } 28 556 " "
Say 57 %

Area of Circle 78 54 " "
Portion of Circle watered twice } 57 11 " "
or 73 %
Portion of Circle watered once } 21 43 " "
Say 27 %

Fig 55



Area of Rectangle 64 95 " "
Area of portion watered twice } 13 59 " "
Say 20 %

Fig. 56

Scale 10 = 1"

3. The next arrangement is similar to the first, but the standards are placed much more closely so that parts of the area commanded overlap. The first arrangement indicates the maximum distance apart for standards. Fig. 55 the minimum. Here the area watered twice is about half the total area, and the best arrangement of this type lies clearly somewhere between these two extremes.
4. The only other possible type of arrangement is the extreme case of No. 2 above, the sides of the equal sided triangles being shortened until no space is left between the circles. The theoretical result is a double dose for about 20 per cent. of the area; but, as in case 3, the best arrangement lies in between the extremes. (Fig. 56.)

In any installation of machinery or appliances, there are at least three things to be carefully considered before making a decision. These are:—

1. First cost.
2. Operating and maintenance cost.
3. Depreciation based on probable life of plant.

The first cost of a plant is often the factor which decides its purchase. But a plant low in first cost may, in the long run, prove more expensive than one the first cost of which appears very high. Take a case in point.

A and B have both 10 acres of cultivation to be irrigated. It is similarly situated and the lift is the same, and the same quantity of water is used by both. But A takes three days to irrigate his 10 acres; B requires only two days for each watering.

	A bought a plant for £800.		B paid £1,100.
Operating Costs—			
Fuel first year	54 0 0	..	26 10 0
Driver's wages	21 12 0	..	18 0 0
Oil, waste, &c.	3 10 0	..	1 0 0
Labour to irrigate	36 0 0	..	24 0 0
Interest at 5 per cent.	40 0 0	..	55 0 0
Depreciation at 10 per cent. ..	80 0 0	8 per cent—	88 0 0
Maintenance, cost of repairs, and extras	30 0 0	..	12 0 0
	£265 2 0		£224 10 0

This shows a saving in favour of the more costly plant amounting to over £40 per year, partly due to the smaller amount of fuel used and the shorter time in which it can accomplish the work, and also because the depreciation on a well-housed and tended plant can reasonably be taken as less than on one indifferently cared for.

Another essential thing is to be sure that the plant obtained is suitable for the locality and crop to be grown. It is just here that the choice may mean success or failure at the outset.

Regarding operating and maintenance expenses, labour to irrigate, &c., it is well to remember that this does not apply to spray systems only, but is equally true where the distribution is done by gravity. Whether the water is obtained by pumping or gravity, the gravity distribution should always be first considered, and if found impracticable or not economical for some reason or other, then, but not till then, should a spray system be considered.

Each irrigator, in installing a spray system or any other machine, would do well not to take things for granted. It is not fair to either party to condemn an appliance simply because its operation has not been fully grasped. As a rule, the vendor is probably just as anxious as the purchaser that the appliance should be a howling success rather than a squealing failure. Mistakes are sometimes made, but reputable houses generally prefer to know about such, as soon as possible, and certainly before anyone else engaged in the same line.

Failure of sprays to work may sometimes be caused by frogs getting into the pipes, and water weed, fungus growths, &c. A very efficient screen on the suction should always be an essential point.

The pressure at which the sprays have been recommended to work should be strictly observed, and a pressure gauge so placed that the operating pressure can be read at any time.

A slight wind is no disadvantage, as it generally ensures a more even distribution; but note should be taken of the prevailing winds and the sprays placed accordingly. Judgment is also necessary in placing the gauging tins.

"Parallel" and "Overhead" Sprays.

As yet there are not many of these in use in this State. Attempts have been made to introduce the system for growing sugar-cane, and in growing vegetables, &c., but most of these plants are still only in the experimental stage. Some makers in the Southern States appear to have had very fair success, but no definite data are to hand.

Sub-Irrigation.

As the term implies, this system aims at supplying the water needed direct to the root region of the growing crops or trees, from beneath the surface. The economy of water usually experienced in this system lies in the fact that the surface is always kept in a fine state of tilth (the surface is never wetted) and evaporation is consequently a negligible quantity. Another advantage is that, owing to the absence of any caking of the soil, the roots are always able to obtain some nourishment indirectly derived from the easy access of air.

The cost of sub-irrigation renders it one of the most expensive methods of irrigation known, but it is also the most efficient. It is a method largely favoured by fruitgrowers in some parts of America, where both land and water realise high prices. One of the advantages of the system is that water at a uniform temperature can be applied just where it will do most good, and where a good deal of forcing is done to catch early markets the system is particularly useful. In porous soils it is stated to be a failure, and to maintain the drains free from root growth and other obstructions makes the method too costly to be recommended except in very special cases.

Some of the Drawbacks of Irrigation.

The chief trouble accompanying irrigation is in most cases caused by the irrigator himself. It has already been mentioned, perhaps more than once, that too much water is bad, whether intentionally or unintentionally applied. Where the subsoil or substratum is porous, the only manifestation of excessive use of water is a leaching of the soil with a corresponding reduction in the yield. But where the substratum is impervious nature punishes the over-indulgent irrigator very severely.

The first sign of soil souring through over watering is usually manifested in dying vegetation. It may appear unaccountable at first, but a hole dug down to a depth of about 4 feet will soon reveal the cause.

If the trouble is coped with adequately, and in time, serious results may be prevented, but the first thing to look for is the cause. If the cause is seepage from channels, the bad places must be lined, as has been done at Yanco, in New South Wales, and Muldura, in Victoria. The subwater surface must next receive attention and by a proper system of drains be lowered in order to obviate the next trouble, which is the appearance of ''alkali'' patches.

In Mildura the subwater surface was, on investigation, found to have risen to a dangerous extent, and some patches of alkali also appeared. Attempts to drain the area by sinking wells have proved successful, as a porous stratum was found about 60 feet below the surface. Wells are now sunk not for water, but to get rid of it; drain pipes and drains discharging the surplus into these wells, where it disappears in the porous strata.

At Bingera, near Bundaberg, the wise precaution was taken to first tile drain the whole of the area, the original intention being to prevent waterlogging. It has already been mentioned how this precaution was found particularly useful in another way.

Where the trouble occurs and is not checked in time, the irrigator is faced with the more serious problem of overcoming the effect of the ''alkali.'' Irrigators usually distinguish between ''black'' alkali and ''white'' alkali. The former, or black alkali, consists chiefly of sodium carbonate, which, when present in excess in soil, dissolves the humus and shows black rings on the white patches where surface waters containing the salt have evaporated. Vegetation grown in soils suffering from excess of the carbonate turns black before it wilts and dies, and the name ''black'' is probably derived from either or both of the above manifestations.

Black alkali is usually considered the worst to cope with, but Professor E. W. Hilyard has shown by actual experiment that the proper antidote for black alkali is a good dressing of gypsum. (This alone will clearly be of no use unless the cause of the trouble is removed by proper drainage, as indicated above.) The gypsum is most beneficial when applied at the rate of about 500 lb. per acre per annum, and with the dressing of gypsum must follow irrigation with drainage to assist the action of the corrective.

To the more inquisitive it may be interesting to know why gypsum (a sulphate of calcium) should have the property of counteracting the evil effects of sodium carbonate (washing soda). The reason is that the calcium in the gypsum in the presence of water combines with the carbonate of the sodium carbonate and the sodium carbonate becomes a sulphate, in which form it is less harmful. Calcium carbonate or carbonate of lime is not a harmful constituent of soil, and the exchange thus effected renders the soil quite fit for crops in about three to four months after the first application.

Chemically the action is thus represented:

$$Ca\,SO_4 + Na_2\,CO_3 + Aq = Ca\,CO_3 + Na_2\,SO_4 + Aq$$

The reason for the exchange being that calcium carbonate is more insoluble than any of the other combinations.

''White'' alkali usually denotes the sulphates and chlorides of sodium and magnesium. Sometimes manganese sulphate and a trace of potassium may be found. (It will be interesting to recollect in this connection Mr. Symmonds' experiments wherein he, by the addition of nitric acid to the soil, converts these harmful ingredients to nitrates, so converting them into valuable fertilisers.)

The cause of the appearance of alkali is due to a concentration by evaporation of the small amounts of these salts, usually found in solution in all waters. Repeated applications without drainage leave the salts in the soil, and finally the soil is so saturated with them that it becomes unproductive.

The more salts carried in solution the sooner will the danger mark be reached. The careful irrigator will keep a close watch on his supply, because sometimes when a river is low, especially near the coast, salt or heavily mineralised waters find their way into higher reaches of the river, which, under ordinary conditions, contain water suitable for irrigation. One application of such water may ruin not only the crop, but spoil the land for some time to come.

The best preventive against heavy evaporation is usually considered to be ''mulching.'' The best mulch is a well tilled surface upon which a crust is never allowed to form. Hence the motto ''Cultivate, Irrigate, Cultivate.''

IMPORTATION OF COTTON SEED AND RAW COTTON—STRINGENT CONDITIONS.

The Hon. W. N. Gillies (Acting Premier and Minister for Agriculture), referring recently to a message from Melbourne to the effect that the importation of cotton seed or cotton lint into Australia, except under certain stringent conditions, had been prohibited under proclamation, stated that this was the outcome of action taken by himself, and which commenced as far back as 1920. Recognising the danger of the possible introduction of pink boll weevil and other cotton pests into Australia through the unrestricted importation of both cotton seed and cotton lint, he made representations to the Federal authorities for the strict application of the Quarantine Act to both these products, and it may be mentioned that a specific instance quoted was the detection of the importation into Rockhampton of an American clock packed in seed cotton.

Following on the earlier representations, the administration of the Federal Quarantine Act Regulations was tightened up, and finally a proclamation was issued that all cotton seed imported into Australia should be landed at Melbourne. Mr. Gillies immediately wired the Director-General of Health strongly objecting to any port other than Brisbane for the entry of cotton seed. He pointed out that this was a most vital matter affecting the future success of the cotton industry in Queensland, where 90 per cent. of the total output of Australia is grown. To this proposal the Commonwealth agreed, and it is understood that the proclamation referred to provides for the prohibition of the importation of cotton seed and raw cotton into Australia subject to the following conditions:—

1. That the permission of the Minister to import the seed shall first be obtained.
2. That cotton seed shall be landed only at the port of Brisbane.
3. That cotton seed on arrival shall be disinfected by heat or by such other method as may be ordered by the Chief Quarantine Officer, and shall after being planted remain in quarantine with its product until released by the Chief Quarantine Officer, during which period it shall be subject to supervision by Quarantine Officers or by officers authorised for the purpose by the Director-General of Health.
4. That imported raw cotton shall be landed only at the port of Sydney, and shall, before being released from quarantine, undergo disinfection either by heat or by hydrocyanic acid gas, or by such other method as may be ordered by the Chief Quarantine Officer.

MOLASSES AS STOCK FOOD.

By J. C. BRUNNICH.

Some rather extraordinary ideas exist in the minds of the public with regard to the feeding value of molasses, and statements which appear from time to time, that a pound of molasses has the same food value as a pound of corn, are absolutely misleading.

Molasses is a purely carbonaceous food, therefore only a heat or energy producing nutrient, and has absolutely no value as a flesh-forming nutrient, as molasses contains no proteins.

Our Queensland molasses contain on an average—

24 to 26 per cent of water.
50 to 58 per cent. of sugars.
7 to 10 per cent. of ash or mineral matter.
18 to 20 per cent. other organic matter, including amides.

The ash itself contains—

38 to 44 per cent. of potash.
8 to 24 per cent. of lime.
1 to 2 per cent. of phosphoric acid.

An average daily ration for a cow, weighing about 8 cwt., must contain an amount of carbonaceous nutrient equal to about 11 lb. of starch, and this amount would be supplied by feeding—

Corn (maize)	13 lb.
Cotton Seed Meal	14 lb.
Pollard	15 lb.
Wheat	16 lb.
Good Bushhay	19 lb.
Molasses	19 lb.

The chief value of molasses as a stock food lies in the fact, that the addition of molasses to dry coarse fodders makes them more palatable and stimulates the appetite. The large amount of soluble salts of potash and lime, and amides, however, acts adversely on the digestion, and may cause scours unless fed in moderate quantities.

The amounts of molasses which can be safely given to animals, as an addition to their daily rations, are as follows:—

	Per 1,000 lb. live weight.
Horses	3-4 lb.
Cows	2½-3 lb.
Oxen	3-4 lb.
Sheep	4 lb.
Pigs	5 lb.

Larger amounts, up to twice the quantities above stated, have been fed successfully.

In Louisiana, mules are given up to 9½ lb. of molasses per head, mixed with corn (grain, cobs, and husks all ground together) and hay. For horses about 1 quart, diluted with water, is mixed with the grain and hay feed.

Molasses is particularly useful when fed in combination with concentrated nitrogenous foods like cotton seed meal, coconut oil cake, linseed meal, &c.

Molasses meals and feeds, made by saturating with molasses and subsequently drying, cotton seed meal, oil cakes, mill offal, peat moss, &c., are put on the market and have good food value. It is imperative that such feeds are made as dry as possible, as they are liable to ferment and become mouldy if they contain too much moisture.

The best and cheapest method to feed molasses is to dilute it with two to three parts of hot water and to mix it with the dry fodder immediately before feeding.

On large farms in America the molasses is mixed and heated in tanks and in special mixing machines thoroughly incorporated with the cut straw or hay.

Molasses should not be given to young calves, and only with caution in moderate amounts to cows shortly before calving.

Molasses containing more than 28 per cent. of water should not be sold as stock food.

ABSTRACTS AND REVIEWS.

All foreign agricultural intelligence in this Section, unless otherwise stated, has been taken from "The International Review of the Science and Practice of Agriculture," published at Rome by the International Institute of Agriculture.

Studies on Poultry Feeding.

I. Schofield, M.A.: Feeding Milk to Poultry. "The National Poultry Journal," Vol. LXII., Part 3, No. 116, p. 151. London, 1922.

II. Wood, D.: Feeding the Heavy Layer; How to Supply the Essentials to Heavy production. *Ibidem,* No. 117, pp. 164-165.

III. Bossert, A.: The Rational Feeding of Poultry. *Ibidem,* No. 126, pp. 295-297; No. 127, p. 305; No. 128, p. 319.

IV. Dobbin, R. C. H.: Some Lancashire Experiments—Wet *versus* Dry Mash. *Ibidem,* No. 131, p. 363.

V. Hepburn, J. S., Holder, R. C., and others: Rations for Feeding Poultry in the Packing House. United States Department of Agriculture, Bulletin No. 1052, 24 p. Washington, 1922.

I. *Feeding Milk to Poultry.*—The by-products of milk (skim milk, whey butter, or condensed milk or whey, whether liquid or in powder) have proved most useful in the feeding both of chicks and of adult fowls. Powdered milk must be dissolved before use in ten times its weight of water. Its nutritive value, if equal weights are taken, is the same as that of meat-meal.

Skim milk can be fed either fresh or sour. It is a mistake to attribute the efficacy of skim milk or whey solely to the lactic acid they contain and to believe that lactic acid can be substituted for the above substances, although a small dose of lactic acid is very good for chicks, as it not only acts as a mild disinfectant of the digestive canal but is also a stimulant and an excellent remedy against coccidiosis and other diseases. If, however, an excessive amount of lactic acid is given, it does serious injury by destroying the mucous membranes; further, it is of no use in the feeding of adult fowls when a well-balanced ration is given; hence it is best to reserve lactic acid for a medicine and to use for food purposes only the by-products of milk.

Skim milk, whey, and a solution of powdered milk are put into the drinking-troughs. The acid solution is made into a mash. Milk powder can also be added to the mash in the proportion of 5 to 10 per cent. About 5 litres of mash per day is enough for 100 fowls. The whey, or solution of powdered milk, should be fed at the rate of at least 5 litres a head for 100 head. By-products of sweet and of acid milk ought not to be given at the same time, but may be fed on alternate days.

From the results of his experiments Schofield concludes that non-acid milk by-products suit young fowls better than acid ones, which ought to be used as a condiment rather than as a food.

II. *Feeding the Heavy Layer.*—Wood has studied the application to the feeding of heavy lawers of our modern knowledge respecting the effect of the mineral constituents and the vitamines in the different feeds. As a result of his own experience he suggests the following ration:—Equal parts of wheat and oats; mash middlings—bran, gluten, fish meal, chopped clover or lucerne hay, dried yeast, soy-bean meal, and ground oats (4 : 4 : 4 : 2 : 2 : 1 : 1). Once in three weeks 2 per cent. of salt should be added to the mash, and once a fortnight 1 per cent. by weight of crude cod liver oil may be introduced.

III. *The Scientific Feeding of Poultry.*—A hen that is not laying should be fed, in order for the ration to be well balanced, for every 100 parts protein 452 parts of carbohydrates and 20 parts of fat. A hen laying 1, 2, 3, 4, 5, 6, or 7 eggs weekly ought to consume respectively, for every 100 parts of protein, 421, 394, 375, 362, 347, 336, or 327 parts of carbohydrates, and 26, 30, 33, 36, 39, 41, or 43 parts of fat. In calculating the ration of a laying fowl, Bossert advises that the egg-production should be estimated at 5 or 6 eggs per week—viz., the ration should be 100 protein, 340 carbohydrates, 40 fats; or, in the simplest terms, 10 : 34 : 4.

The following rations fulfil all these conditions per ten head and per day:—

(1.) Middlings 280 gm., meatmeal 80 gm., wheat 370 gm., maize 110 gm., hemp seed 110 gm., bonemeal 14 gm., green food (grass and roots) 800 gm.

(2.) Middlings 200 gm., fishmeal 100 gm., wheat 400 gm., maize 100 gm., hemp seed 140 gm., bonemeal 14 gm., green food 800 gm.

The grain is given separately but at the same time as the other substances (which are mixed into a mash) both morning and evening; the green food is given midday.

IV. *Dry versus Wet Mash.*—This paper gives an account of various experiments described and discussed at a meeting of the Lancashire Utility Poultry Society. Most of the experiments had been carried out on the county farm, at Hutton, and show that wet mashes should not be discontinued but given alternately and supplemented by grain fed separately, and by green food.

V. *Fattening Rations for Poultry.*—When, as is the case in the United States, poultry are sent long distances, they should not be fattened by the rearer, as the birds lose their finish on the journey, and the sender cannot despatch them as frozen meat. Therefore the poultry-rearing industry has to be divided into two branches—the production and fattening branches respectively. Fattening takes one to two weeks and is carried out at the packing-houses.

Poultry-fattening as a specialised industry is making rapid progress in the United States; this induced the author to carry out his investigations in the Food Research Laboratory of the Department of Agriculture of the United States. He compared different rations and determined:—

(1.) The increase in live weight obtained.

(2.) The improvement in the edible portions of the fowl.

Two kinds of experiment were carried out; in the first, various tests were made for each ration with twelve fowls fed and studied separately.

In the second class, the so-called battery experiments, a larger number of fowls (up to over one thousand in a lot) were studied in flocks. The rations fed the control lot consisted of maize-flour and butter-milk (40 : 60). In the experiment rations, part of the maize-flour and of the butter-milk was replaced by one or more of the following foods:—Barley, maize-flour, whole oats, entire oatmeal, oatmeal patents, ground oats, rice bran, rice husks, ground rice, wheat offals, wheat middlings, coconut cake, ground decorticated ground-nut cake, undecorticated ground nut cake, colza cake, soy-bean cake, kafir, ground milo, lucerne, meat scraps, condensed whey, or powdered whey. The fowls were weighed on the 1st, 4th, 8th, 11th, and 14th days of the experiment.

One table gives the composition of the foods used; the other twelve give the results of the experiments.

The averages of the most important results are to be found in the following table:—

Classes of Birds.	No. of Birds per Class.	Increase in 4 Days.		Increase in 8 Days.		Increase in 11 Days.		Increase in 14 Days.
Cockerels	612	12	30	23	57	31	78	40
Pullets	396	..	..	17	60	24	85	29
Adult Cocks ..	336	11	50	17	77	21	93	22
Hens	456	4	34	8	65	10	84	12

The younger birds (cockerels and pullets) increased most rapidly in live weight when given a concentrated protein food, such as cake or meat scraps. The hens did not give uniform results, from which it would appear that meal suits them as well as a concentrated protein food.

The best length for the fattening period depends to a great extent upon circumstances. A fortnight is certainly not too long for cockerels, since they continue increasing in weight rapidly for this time; whereas pullets gain all their weight in eleven days. In the case of adult cocks and hens, the fattening period must be limited to six to eight days.

The analyses made of the different parts of the body of a large number of birds belonging to the various classes showed no difference produced by the rations on the composition of the edible portions, or the dressing losses, although the classes differ perceptibly in both these respects.

The yield of edible portions (in percentage of live weight) was for unfattened and fattened birds respectively:—Cockerels, 56 and 60; pullets, 63 and 67; cocks, 62 and 64; hens, 70 and 71; which shows the advantage of fattening. In the last chapter is given the composition of rations for fowls that are to be fattened.

The Food Value of Sugar.

"The World's Work."

The people of the United States spend about 100 millions sterling on soft drinks every year. Most of those contain a good proportion of sugar, the dietetic value of which must not be overlooked. Sugar is superior to alcohol as a self-starter. Experiments in the Nutrition Laboratory of the Carnegie Institution of Washington show that sugar is absorbed and consumed in the body as soon as alcohol or even sooner. Within four to ten minutes after sugar is taken on an empty stomach the effect is shown in the rise of the respiratory quotient. Milk sugar and fruit sugar begin to burn up in the body quite as soon. Glucose and maltose require twenty minutes or more before they become important in metabolism.

In experiments at another station it was found that five ounces of sugar a day added to the ordinary diet increased the available energy of the ration by 25 per cent. There was increased economy in the utilisation of protein by 25 per cent. with the added sugar—although sugar contains no protein.

A study of dietaries in 500 representative families shows that sugar in the various forms of food provide 10 per cent. of the total energy.

Sugar beet stands at the head of all the crops of the temperate zone in the amount of food energy that can be produced in a given area. They are the most efficient of all our machines for the fixation of solar energy in a form so that it can be used in the human body to produce muscular power.

Sugar is a quick-action energy-producing food. It therefore comes more and more into demand as daily life speeds up. Its consumption might be used as a measure of the individual activity of a country. The United States stands at the head of the list in the amount of sugar used, 5,010,757 tons in 1922. This is an increase of 17½ per cent. over the consumption in 1921.

From this it appears that they are consuming 102 lb. each on the average during the year. In dietary experiments it has been found that as much as three-quarters of a pound of sugar a day can be included in the ration of a hard-working man without injurious consequences. This is nearly three times the average national consumption.

Before the war the per capita consumption of sugar by the leading nations of Europe was:—United Kingdom 87·9 lb., Germany 39·7, France 39·1, Russia 15·8, Italy 10·1. Since the war Italy has raised her ration of sugar to 15·4, an indication of an access of energy which is apparent in various other ways. Great Britain, on the contrary, has reduced her ration to 71 lb., of which 19 lb. goes into the manufacture of jams, candy, and beer, much of which is exported.—"The World's Work."

Why do Cream Tests Vary?

H. B. ELLENBERGER—Cream and Milk Plant Mo., 12 (1923), No. 7.

In experiments at the Vermont Experiment Station it was found that the following factors tend to influence the fat content of separated cream:—Low temperature of the milk, high speed of the separator, rich milk, use of a small quantity of milk in flushing the bowl, or reduced rate of flow of the milk into the separator. An unclean or unbalanced bowl may cause considerable variation in the cream test and may reuslt in greater losses of fat in the skim milk.

Methods of Preserving Eggs.

D. B. SWINGLE and G. E. POOL—Montana Sta. Circ., 111 (1923).

The results of a series of tests of different preservatives for eggs are briefly reported. Waterglass in strength of 1·25 was found to be the most satisfactory for home use. Various forms of grease and patented preservatives maintained the quality of the eggs for four or five months, but they were more expensive and not as certain or lasting as the waterglass.

Experiments in the Storage of Fruits.

D. B. ADAM—Jour. Dept. Ag., Victoria, 21 (1923), No. 3.

Studies conducted in the Government Cool Stores, Melbourne, indicated that 32 deg. F. was a more satisfactory temperature for storing pears than were either 34 or 37 deg. Fruits at the two higher temperatures blackened shortly after removal from storage, preventing sale, and wrapping with paper had no apparent effect in preventing this blackening.

The stage of maturity at time of harvest proved to be an important factor. Kieffer pears harvested when slightly green kept much more satisfactorily than did more mature fruits. It is suggested that the blackening of pears in storage is the result of chemical changes which convert arbutin of the skin into hydroquinine and glucose and then into quinone and water. Of the several pear varieties tested, the Kieffer was by far the most susceptible to blackening.

The amount of pathological decay present on stored pears was found to be dependent upon the variety, cultural conditions under which grown, stage of maturity at harvest, and the care in handling. In comparing the effect of wrapping every layer, alternate layers, and no wrapping on Winter Nelis pears, it was evident that all fruits should be wrapped. In a test of the effect of three systems of air circulation on the percentage of mouldy fruit, no one system was found superior. Winter Nelis pears from an irrigated orchard kept as well as fruit from a non-irrigated orchard. Brief notes are given upon the keeping qualities of several varieties.

A GREAT OPPORTUNITY FOR QUEENSLAND.

It has already been announced that the Empire Press Association has arranged to hold its annual conference in Australia early in 1925. This will mean the visit to our shores of a large body of influential British pressmen, as well as delegates from all parts of the British Dominions. Undoubtedly every opportunity will be taken in the Southern States to make our visitors as fully conversant with this great Commonwealth and its people and industries as time will permit. If the usual routes of travel are adopted, this will probably mean that a portion of the delegation may find their way to Brisbane, *viâ* the Darling Downs, with possibly a side trip as far as Bundaberg, a programme with which we are all familiar, and whose utter futility as a means of enabling visitors to gauge the vast resources of this State, most Queenslanders would be prepared fully to admit.

It has been suggested that whilst the visiting pressmen will no doubt take varying routes from England to this continent, every effort should be made to induce as many as possible to travel by way of Singapore, affording an opportunity to make direct acquaintance with the naval base question. Thence a short run to Batavia and by rail to Sourabaya would present many objects of interest, including acquaintance with the sugar industry of Java. The voyage could be resumed by one of the regular steamers plying between that port and Cairns, *viâ* Torres Strait and Thursday Island. Apart from the many features both of island scenery and Dutch and native life and industry which such a route would offer, as compared with the monotonous run across the Indian Ocean from Colombo, the suggested variation would permit of a comprehensive, if rapid, view of North-eastern Australia. Landing at Cairns, a very few days would permit of a visit to the Atherton Tableland, and one or two of our largest sugar-mills. Thence the party could travel by rail to Townsville, as the North Coast Line is to be completed before the date fixed for their arrival in 1925. From this point their journey might be pursued *viâ* Winton and Longreach to Rockhampton, thus enabling the visitors to gain glimpses of our vast interior and its great pastoral industry. If time should permit a delay of a couple of days it would show the extensive sugar-fields of the Burnett and Isis areas, with the thriving cities of Maryborough, Bundaberg, and Childers; and if arrangements could be made for the run through from Gympie to Brisbane by daylight, a further opportunity would be afforded of estimating something of the wonderful richness of this vast territory.

This, to anyone knowing even a little of the geography of our State will appeal as an ideal method of advertising Queensland; and with the display at Wembley Park fresh in their minds, our visitors would quickly pick up the threads of information. It would mean their ultimate return to their homes with a far different impression of the Commonwealth as a whole than if they landed first at Fremantle in the ordinary way. At the same time, it would be quite open for them to take the western route on the journey back to England, and by that means they would practically have circumnavigated the continent, gaining an idea of its potentialities, which no amount of time spent in the capital cities could give them. These are the rough outlines of a scheme originating in the mind of a public-spirited citizen of Cairns; but if it is to be given effect, immediate steps should be taken to organise a persistent and clear-headed advocacy of the plan, both in Australia and in the Old Country, so that the proposals may not be forestalled on the one hand, and so that, on the other, our intending visitors may have time to fully weigh the advantages of the suggested route.

BUNCHY TOP CONTROL.

Affected Areas Proclaimed.

Strict precautions have been taken by the Government to guard against the spread northward in Queensland of bunchy top in bananas. The Acting Premier and Minister for Agriculture (Hon. W. N. Gillies) announced recently that, in order to prevent, if possible, the further spread of bunchy top from the areas in Queensland in which this affection was now present to any other part of the State, a proclamation had been issued for the purpose of dividing the South Coast fruit district into two divisions.

The first division is that adjacent to the New South Wales border on the south, and bounded on the north and west by the Logan and Albert Rivers. Outside of this area, no bunchy top has so far made its appearance; neither is there any bunchy top known to exist within some miles of its northern or western boundary. The proclamation prohibits the transfer of any banana plants out of this division to any other part of the State, consequently the department hopes by this means to prevent the spread of the affection by means of plants.

Further, the area of land lying immediately to the south and east of the Logan and Albert Rivers, in which no bunchy top is now known to exist, will be kept under strict surveillance, and, should bunchy top make its appearance in any banana plant or plants in this area, the plant or plants will be forthwith destroyed.

Areas Affected.

So far, bunchy top in Queensland is practically confined to the plantations that are either in direct touch with those of New South Wales, or to plantations which are either contiguous to these plantations, or are at no great distance from them. Bunchy top has only been found in a few instances outside of what might be termed the main infected area, and is not spreading rapidly. In fact, it is satisfactory to know that in the case of one of these outbreaks, the affection is no more noticeable now than it was when first discovered some twelve months since. Every possible precaution will be taken by the department to prevent the northern spread of bunchy top, and, as already stated, any further outbreaks that may occur in the clean area of No. 1 division will be systematically and promptly dealt with.

Plan of Campaign.

The effect of dividing the South Coast fruit district into two areas will, therefore, be that a strenuous endeavour will be made to prevent the extension of the affection from the existing plantations, and to confine it entirely within its present limits. The clean area between the presently known infested district and the Albert and Logan Rivers will act as a buffer area, and, further, the whole of No. 2 division, that is, the whole of the South Coast fruit district other than that contained in No. 1 division, which extends as far north as the Brisbane River and the railway line running from Indooroopilly to the Toowoomba Range, will also act as a second buffer area, thus providing a double line of defence against the spread of the affection to any other part of the State.

Officers of the Department of Agriculture have been, and still are, making a careful inspection of the area immediately to the south and east of the Logan and Albert Rivers, and this inspection will be systematically continued.

Bunchy Top—Investigations Continued.

In August of last year the Acting Premier and Minister for Agriculture and Stock (Hon. W. N. Gillies) announced that the Queensland Government would give £1,500, being an amount equal to that which the Commonwealth Government then proposed to allot, for investigations into the bunchy top disease in bananas, provided that the New South Wales Government would contribute a like amount.

Mr. Gillies announced recently that since that time negotiations had been carried on between the two States and the Commonwealth Institute of Science and Industry. The arrangement between New South Wales and Queensland, whereby a joint report by Dr. Darnell Smith, the Entomologist of the Department of Agriculture in New South Wales, and Mr. H. Tryon, the Chief Entomologist of the Queensland Department, relating to the investigations to 31st December last, is to be issued, will be continued until the publication of the report. A joint report now, however, is out of the question, as Mr. Tryon is still undergoing hospital treatment for the injuries he received recently, but the Under Secretary of the Department of Agriculture in New South Wales has promised that the issue of a report by Dr. Darnell Smith may be shortly expected.

An agreement was also made that each of the Governments should appoint a scientist to a small committee for the purpose of inquiring fully into the investigations in the past, to advise as to the existing position, and to make recommendations as to further investigations, the report of this committee to be made not later than 1st March next. Executive approval has now been given to the extended scheme. The representative of Queensland upon the Committee of Investigation is Professor E. J. Goddard, B.A., D.Sc., of the Queensland University; the representative of the Commonwealth will be Professor Richardson, M.A., B.Sc., Dean of the Faculty of Agriculture in the Melbourne University; and of New South Wales, Professor R. D. Watt, M.A., B.Sc., Chair of Agriculture in the Sydney University. The preparations for a campaign against bunchy top have thus been made, and as soon as the report of Dr. Darnell Smith was available the committee will be called together by the New South Wales Government to commence its investigations.

"Bunchy Top"—A Buffer Area Proclaimed.

A Proclamation has been issued rescinding the Proclamation dated the 9th September, 1921 (which prohibited the removal of any plant of the genus Musa (Banana) excepting only the fruit thereof from or out of any nursery, orchard, or other place in Queensland beyond the boundaries of an area defined as "The South Coast Fruit District"), and proclaiming that the removal of any plant of the genus Musa (Banana), excepting only the fruit thereof, from or out of any nursery, orchard, or other place in the areas more particularly described as under, to any place in Queensland beyond the boundaries of either of the said areas, is prohibited from the 22nd December, 1923:—

> Commencing on the sea-coast at Point Danger, and bounded thence by Macpherson Range westerly to the source of the Albert River, by that river and the Logan River downwards to the mouth of the latter, by a line passing to the south of Russell Island easterly to Stradbroke Island; and thence by the western shore of that island, a line, and the sea-coast southerly to the point of commencement.
>
> Commencing at the mouth of the Logan River, and bounded thence by that river and the Albert River upwards to Macpherson Range westerly to the Great Dividing Range, by that range north-westerly to the Southern and Western Railway at Harlaxton, by that railway easterly to the Brisbane River, by the right bank of the Brisbane River downwards to its mouth; and thence by the western shore of Moreton Bay south-easterly to the point of commencement;—inclusive of the islands in Moreton Bay north of a line running from the mouth of the Logan River and passing to the south of Russell Island.

The Cheapest Land Labour.

Thus "The World's Work," in discussing the sugar industry:—"The most intelligent and highest-paid labour using scientific methods and power will run out the cheapest land labour."

A MILK-TAINTING WEED *(Monococcus echinophorus).*

The attention of dairymen is called to a weed or shrub which is at the present time a frequent cause of a very serious defect in cream. This plant is not usually eaten by cows, but sometimes in time of drought one or more cows of a herd will take a liking for it, with the result that, if their milk is mixed with that of others, the whole becomes tainted. The taint is abominable and is so penetrating that the cream from the milk of a single cow, fed on the plant, will taint a whole vat of cream and the butter made therefrom; and as cream so tainted is liable to be condemned as unfit for human consumption it behoves dairymen to be on the lookout for cows addicted to the habit of eating it and to exclude their milk from use for dairy purposes.

The late Mr. F. Manson Bailey, Government Botanist, some years ago classified the plant as belonging to *Monococcus echinophorus* of the Natural Order of Phytolacea; but I know of no common name for it. It may, however, be recognised by the following description:—It usually grows on scrub land, in sheltered spots, such as the edges or pockets of a scrub. It grows to the height of 1½ to 2½ feet, and bears bunches of small red berries of a diameter of about one-tenth of an inch. When crushed the leaves give off a very unpleasant smell. Cows that eat the plant are easily distinguished from others by the fact that their milk tastes and smells of the plant, and their excreta gives forth a very unpleasant odour.—FREDERIC J. WATSON, Instructor in Dairying.

General Notes.

Cotton Act Regulations.

Regulations have been issued under "*The Cotton Industry Act of 1923*," which provide that until the 31st July, 1924, the following prices are guaranteed to growers for seed cotton acquired for the Crown under the said Act and delivered at the railway station or port nearest to the land whereon such seed cotton was grown:—

Cotton of less than $1\frac{1}{4}$-inch staple	5d. per lb.
Cotton of $1\frac{1}{4}$-inch staple and over	$5\frac{1}{2}$d. per lb.

the words "seed cotton" meaning seed cotton that is free from excessive dirt, leaf, stain, extraneous (added) moisture and immature fibre, and is not damaged by weather, &c. The decision of a Government grader shall be final as to whether any cotton comes up to the standard. Weights as determined at an authorised factory shall be accepted unless satisfactory evidence to the contrary is produced. An officer of the Department of Agriculture and Stock shall supervise the weighing of all consignments of seed cotton at an authorised factory. All seed cotton delivered at a railway station or wharf must be properly bagged or baled, marked, and consigned freight on to the nearest authorised factory. Different qualities of seed cotton must not be packed in the same bag, bale, or other container. Orders from growers for the payment to any person of the proceeds of any consignment of cotton shall not be accepted, and all seed cotton acquired under this Act not brought in direct to the gin shall be delivered to and accepted by the Minister for Agriculture on railway trucks at authorised factories, as the Minister may decide.

An Order in Council has also been issued by which all seed cotton now within the State of Queensland and grown within the State before the thirty-first day of July, 1924, shall be and is acquired for the Crown.

A Proclamation has been issued, proclaiming that the period for or during which the Crown guarantees a price for seed cotton shall be from the 17th January, 1924, to the 31st day of July, 1924.

Matured Fruit Defined.

As some pineapple-growers appear to be uncertain as to the exact meaning of "matured fruit," as applied to pineapples in the regulations under the Fruit Cases Acts, issued on the 16th November last, the Acting Premier and Minister for Agriculture and Stock (Hon. W. N. Gillies) has referred the matter to the Director of Fruit Culture and the Agricultural Chemist, from whom he has received the following report:—

> It is very difficult, if not impossible, to determine accurately the degree of ripeness from an external examination of the fruit, as the term "matured fruit," when applied to pineapples, is dependent on the percentage of sugar present in the fruit, which must not be less than 10 per cent. during the months of October to March inclusive, or 8 per cent. during the months of April to September inclusive. The percentage of sugar can only be determined accurately by making an analysis of the juice, but for all practical purposes if the juice is expressed, placed in a beaker or similar vessel, and tested with a Brix saccharometer, and if found to register 12 degrees during the summer months and 10 degrees during the winter months, this should give the 10 and 8 per cent. respectively of sugar required by the regulation. At the same time, the following indications of ripeness will be of assistance to growers:—
>
> *Summer Months.*—The pips should be full and the dark vivid colour should show a sign of becoming lighter or paler, even though there is no appearance of yellowing at the base of the fruit. The fruit when cut should be juicy, and the flesh showing a slight yellowish tinge, but if the flesh is white and woody, the juice scanty and of a slimy nature or insipid flavour, the fruit is immature. There should be a fair quantity of juice which should possess a distinct sugary taste.
>
> *Winter Months.*—The pips should be full, and the base of the pine should show colour. If picked at an earlier stage, especially in the case of smoothleaf pines, the fruit will never develop its sugar contents.
>
> A local firm can manufacture suitable small Brix spindles for the testing of pineapple juice at a reasonable cost.

L.P.A. Elections—A Regulation Revoked.

Regulation 11 under "*The Primary Producers' Organisation Act of* 1922" has been revoked, and in lieu thereof a Regulation has been issued stating that the rolls of all Local Producers' Associations shall be closed for the purpose of the election on a date to be fixed by the Council, and notified to the secretary of every Local Producers' Association by the Council. Such date shall be at least fourteen days before the last date fixed for the receipt of nominations. The secretary of each Local Producers' Association shall furnish to the returning officer, as set out in Form No. 4 in the Schedule hereto, or to the like effect, a complete roll showing names and addresses of persons who were members of the association on the day fixed for closing the rolls, and such roll must reach the returning officer not later than the last date for the receipt of nominations. Such roll shall be certified by the chairman and secretary, and shall be used by the returning officer as the official roll of members entitled to vote at the election: Provided that if the certified roll does not reach the returning officer in time to be used at the election, the returns of members filed by the Council in pursuance of Regulation 7 of these Regulations may be used as the roll for the election.

Fruit and Vegetable Quarantine.

The Acting Premier and Minister for Agriculture and Stock (Hon. W. N. Gillies) has received from the Acting Prime Minister (Dr. Earle Page) the following modification of the Quarantine Regulation issued recently by the Department of Agriculture, United States of America, relative to the importation of fruit and vegetables into that country from Victoria, South Australia, and Tasmania. The same authority also issued a warning, dated 30th October, 1923, against the importation of overripe or damaged lemons:—

> The quarantine restricting the entry of all fruits and vegetables into the United States, which becomes effective 1st November, 1923, has been amended to make provision for the entry of certain hothouse-grown fruits and of other specialties which can be accepted by the United States Department of Agriculture as free from risk of carrying injurious insects, including fruit flies. The original wording of the quarantine made possible the entry of any vegetables which could be so determined, but the entry of fruits was limited to a definite list with certain exceptions as to a comparatively small number of countries and districts.
>
> From information which has come to the Department subsequent to the public hearing preliminary to the issuance of this quarantine, it develops that certain fruit specialties, from the nature of their production or of their utilisation in this country or any of its possessions, may properly be considered as presenting no risk. This amendment provides for the entry of such specialties as properly come under the general purposes of the quarantine.
>
> The entry of no fruit will be authorised under this amendment until it has been submitted to and approved by the experts of the Department. Entry under this amendment has been approved for the following fruit specialties:—
>
> 1. Hothouse-grown grapes, when they can from place of origin and manner of growth be considered as absolutely free from risk.
> 2. Sour oranges from Spain imported for marmalade manufacturing, with entry limited to northern ports and for use in northern factories under full control, the process including prompt cooking of the fruit and the burning of all waste, including packing material and crates.
> 3. Avocados from the West Indies. The question of the importation of such avocados was not raised at the fruit fly hearing of 19th December, 1922, and in drafting the quarantine the entry of avocados from the West Indies was not provided for. This omission was due to oversight, or rather to the failure of growers or importers or others in interest to bring the need for the entry of this fruit to the attention of the Department. Inasmuch as the quarantine provides for the entry of citrus fruit from the West Indies, and as the avocado, so far as known, is even less open to the question of risk of bringing pests than citrus fruit, it seems unreasonable to exclude avocados originating in the same localities. Entry of avocados, as with West Indian citrus fruit, will, however, be limited to northern ports, at least until it can be fully determined, both by field studies in the West Indies and by examination of the imported fruit, that such fruit is free from all risk whatsoever, in which case entry may be provided for at any port.

It seems desirable to bring to the attention of all permittees under the new fruit and vegetable quarantine (No. 56), promulgated by this Department, effective 1st November, 1923, that while this quarantine permits the entry of lemons and certain other fruits and most of the vegetables under permit, and without restriction as to quantity, this permission with respect to lemons particularly is under the belief that properly-cured and well-selected lemons will not be a means of introduction into the United States of the Mediterranean fruit fly. It is known, however, that this fruit fly will place its eggs in lemons and may come to maturity in bruised or otherwise injured and in overripe lemons. It should be a matter of particular concern, therefore, on the part of the grower and shipper to see that the fruit is absolutely sound and free from injury and not overripe, or in any condition likely to increase the chance of infestation by or carriage of fruit flies.

It is desirable also that similar precautions should be taken in the selection of other permitted fruits, including bananas, pineapples, sour limes, and grapes of the European or vinifera type, or any other fruit, and also any vegetable, the entry of which into the United States is permitted under the quarantine.

It is urged that permittees instruct the growers or exporters with whom they are dealing to so select and grade their lemons and other fruits and vegetables as to eliminate conditions which may increase the risk of including infested material, or subject the shipment to the suspicion of infestation through the inclusion of culls, overripe, or damaged products. By so doing, any necessity for the enforcement of additional restrictions may be largely avoided. Such shippers and growers should also be warned to see that the shipments are free from leaves, twigs, or other portions of plants used as packing or otherwise.

Regulations Under "The Stock Foods Act of 1919."

The Regulations under "*The Stock Foods Act of* 1919," dated 15th January, 1920, have been revoked and new Regulations in lieu thereof appear in the *Government Gazette* of the 22nd December, 1923, from which it is noted that a copy must be constantly affixed in or on some conspicuous place in every shop, shed, or warehouse where stock foods are sold.

Regulation 1 gives a list of the mixed, concentrated, or prepared stock foods or by-products that require to be labelled; also a list of stock foods of low food value.

The Schedule sets out the different substances that are prescribed as foreign ingredients; also the proportion or amount of such foreign ingredients allowed.

Attention is directed to both the Schedule and definitions, in particular those relating to bran, pollard, and calf foods, as well as to the foreign ingredients which include bunt (*Tilletia tritici*).

Regulation 9 prescribes the form of statutory declaration to be forwarded by every wholesale seller of mixed, concentrated, or prepared stock food or prescribed by-product.

A wholesale seller under the Act is:—"Any person who, whether as manufacturer, importer, or wholesale seller, is primarily responsible for putting on the market any mixed, concentrated, or prepared stock food or any prescribed stock food."

If the wholesale seller of any stock food is not resident in the State of Queensland, the requirements of section 3 of the Act may be complied with by a duly authorised agent of such seller resident in Queensland, and such agent shall, for the purposes of the Act, be deemed to be the wholesale seller of the stock food.

The Queensland Agricultural High School.

The Queensland Agricultural High School and College was opened at the beginning of the month under the direction of Mr. J. K. Murray, B.A., B.Sc., N.D.D. The courses at the institution have been so designed that sound education as well as practical and theoretical instruction in agriculture and animal husbandry will be provided. A junior as well as a senior course has been planned, but, as accommodation is limited, it is not intended to receive junior students in the course of the current year. Ultimately, with the institution of a junior course, the term of the senior course will be reduced to two years. The senior course will qualify students for entry to the University agricultural course. After two years' further study under University auspices, students may qualify for a diploma in agriculture. The chief intention, however, is to give the State each year a group of young farmers, admittedly lacking in experience, but thoroughly practical in their outlook and ability and provided with the world's latest knowledge of scientific methods as applied to the practice of agriculture.

Staff Changes and Appointments.

Mr. F. B. Rutledge has been appointed Government representative on the Adavale Dingo Board, and Messrs. W. Hazlett, E. R. Maule, J. Presnell, and J. R. Wade have been elected members of that Board.

Messrs. W. J. Malone, J. H. Ledlie, W. E. Challacombe, and J. K. Casey have been elected members of the Carpentaria Dingo Board.

Messrs. R. Bushnell, T. E. Green, A. E. Jones, and A. Graham have been elected members of the Burnett Dingo Board.

Police Constables D. Crane, T. J. King, S. D. Beakey, and W. J. Laing have been appointed inspectors under and for the purposes of "*The Slaughtering Act of* 1898."

The appointment of Mr. L. L. Gudge as Cotton Classer, Department of Agriculture and Stock, has been confirmed as from the 1st July, 1923.

Mr. J. P. Orr, Clerk, Fruit Branch, Department of Agriculture and Stock, has been also appointed Acting Registrar of Primary Producers' Co-operative Associations under and for the purposes of "*The Primary Producers' Co-operative Associations Act of* 1923."

Mr. R. E. Haseler has been admitted to the Professional Division of the Public Service and appointed Assistant Grader (Senior), Cotton Section, Department of Agriculture and Stock, as from the 22nd December, 1923; such appointment to be on probation for six months.

Mr. E. J. Shelton has been appointed an officer under the Stock, Slaughtering, and Dairy Produce Acts.

Mr. A. R. Charles has been appointed Government Representative on the Western Downs Dingo Board, and Messrs. E. W. Dowling, W. J. Tomkins, W. R. Bracker, and G. F. W. Goodrich have been elected members of that Board.

The Police Magistrate, Charleville, has been appointed Government Representative on the Warrego Dingo Board, and Messrs. J. W. S. Gildea, J. O'Sullivan, M. L. Williams, and W. W. B. Hogarth have been elected members of that Board.

Mr. F. A. Richter has been appointed an Honorary Inspector under the Diseases in Plants Act.

The appointment of Mr. A. Hamilton as Agricultural Field Assistant, as from the 19th May, 1923, has now been confirmed.

Messrs. G. Evans, W. G. Wells, K. V. Henderson, R. R. Anson, J. Carew, A. Nagle, T. Y. Bonar, S. T. J. Clarke, R. W. Peters, L. L. Gudge, and W. H. Franklin, have been appointed inspectors under and for the purposes of "*The Cotton Industry Act of* 1923."

The Officer in Charge of Police, Bollon, has been appointed an acting inspector of stock.

The appointment of Mr. Alfred Nagle as Agricultural Field Assistant, as from the 19th May, 1923, and as Senior Field Assistant, Cotton Section, Department of Agriculture and Stock, as from the 12th October, 1923, has been confirmed.

Mr. J. E. N. Bell has been appointed Government Representative on the Dawson Dingo Board, and Messrs. A. K. Cullen, C. Knack, R. L. Scott, and J. Mundell have been elected members of that Board.

Mr. F. W. Becker has been appointed an officer under and for the purposes of "*The Diseases in Plants Act of* 1916."

The resignation of Mr. Jas. Carew as Inspector of Stock, Brands, and Slaughter-houses, has been accepted as from the 31st January, 1924.

The following have been appointed members of the Dingo Boards for the undermentioned Dingo Districts:—

Wide Bay.—Henry James Hyne, Norman George Hall, John Caradoc Evans, and Frederick McDonald Hooke.

Condamine.—William Nash (Government Representative), Edward J. Ryan, George Mundell, Daniel H. Butler, and James W. Newbery.

Kennedy.—Hugh George Alston, Henry John Atkinson, Leland Edwin Challands, and William Stanley Collings Warren.

St. George.—Donald Norman Roylston Munro, Frank Leslie Treweeke, Ernest Henry Walmsley, and Walter Henry Wippell.

Alexander Percy Devereux has been appointed an honorary inspector under and for the purposes of "*The Diseases in Plants Act of* 1916."

The following have been appointed Government Representatives on the St. George, Wide Bay, and Mitchell West Dingo Boards, respectively:—Wm. D. Cameron, John Taylor, and C. B. P. Bell.

A. McT. Thorburn and H. Collard have been appointed Inspectors under and for the purposes of "*The Diseases in Plants Act of* 1916."

C. R. St. Clair Von Stieglitz, Assistant under the provisions of "*The Sugar Experiment Stations Act of* 1900," has been appointed Analyst, Agricultural Chemical Laboratory, as from the 1st July, 1924.

John Stuart, of Glen Alvon, has been appointed an Honorary Inspector of Stock.

The following have been elected Members of the Dingo Board for the Dingo District of Mitchell West:—William Avery, Angus N. Mackay, James McC. Kowatson, and William L. Cowen.

The following appointments have been made in the Advances to Settlers Branch, State Advances Corporation:—A. P. Deshon to be Assistant Manager, A. C. Palmer to be Senior Clerk, R. R. Craig, A.F.I.A., to be Accountant, and J. L. Gasteen to be Securities Officer.

The appointment of Mr. A. E. V. Richardson, M.A., B.Sc., as a member of the committee appointed to investigate the disease known as "Bunchy Top" in bananas has been rescinded, and Mr. T. G. B. Osborn, D.Sc., has been appointed in his stead to represent the Commonwealth Institute of Science and Industry.

Mr. Charles Cooke, of Riversleigh, Upper Pilton, Clifton, has been appointed an Inspector of Stock.

Economics of the Sugar Industry.

If the estimate of 260,000 tons of raw sugar for Queensland is realised, the crop should be of the value of £7,020,000 to this State.

The second highest yield of sugar in Queensland was produced last year, viz., 287,780 tons, the record output being 307,714 tons in the year 1917. Although the yield of sugar was so good in 1922, it was the result of the greatly increased acreage of cane planted as the outcome of the 1920 agreement between the Federal and State Governments and the high sugar content in the cane, rather than of an increased yield of cane per acre, as climatic conditions generally were unfavourable to a maximum crop. During the wet season period—January to April—1922, the usual volume of rain did not fall, the Southern rainfall being particularly low. Good rains were experienced in June and July, which considerably improved the crop for the time being, but the remainder of the year, unfortunately, proved very dry. The 1922 season was the last one covered by the agreement whereby the price of raw sugar was fixed at £30 6s. 8d.

Under this agreement the sugar industry progressed very considerably. At the commencement of the three-year period there was a feeling of security in knowing that the industry was not to be interfered with for that time. As pointed out in last year's report, this led to the bringing of new areas under cane, the opening up of new districts, and the increasing of the capacity and efficiency of nearly every sugar-mill. The yield of sugar in 1921 and 1922 overtook the consumption and conclusively proved what could be done if stability were afforded to the industry.

The total acreage under cane in 1922 was estimated by the Government Statistician to be 202,303 acres—the greatest area ever put under this crop, being an increase of 39,584 acres above that of 1920 and 17,690 above that of 1921. Of this area 140,850 acres were crushed, this being also the largest area of cane ever cut, exceeding by 17,894 the acreage cut in 1921.

The balance of 61,353 acres not cut during the 1922 season included cane allowed to stand over till 1923, cane cut for plants, and cane planted for 1923. The average yield of cane per acre, due to the drought, was not so good as in the previous year, being only 15.39 tons, as against a yield of 18.60 tons in 1921. The total tonnage of cane harvested was 2,167,990 tons, a decrease on the previous year's figures. The yield of sugar per acre was 2.04 tons per acre, also lower than the yield of 1921.

It is pleasing to note that, due to the activities of the Bureau of Sugar Experiment Stations and the Cane Prices Board creating a demand for better varieties of cane, and also due to the higher efficiency in our raw sugar-mills, the tons of cane taken to make 1 ton of sugar has improved considerably in recent years, but the year 1922 saw the lowest figure yet obtained in this respect, viz., 7.53 tons of cane to 1 ton of sugar. This was, however, partly owing to the drier season producing a higher density cane in the wetter areas, such as Babinda and Innisfail.

The return of molasses manufactured is given as 10,318,879 gallons, made up as follows:—

	Gallons.
Sold to distillers	1,671,484
Burnt as fuel	2,539,142
Used or sold for feed	1,916,393
Sold for other purposes	102,740
In stock	803,050
Used for manure	322,113
Ran to waste	2,963,957
	10,318,879

—23rd Ann. Rpt., Bur. Sugar Expt. Stns., Q.

Rinderpest Precautions.

In connection with the outbreak of rinderpest in Western Australia, the New Zealand authorities have now amended their Quarantine Regulations to provide that Ministerial consent must be obtained for the importation of sheep and pigs from Australia. The introduction of fodder into New Zealand form Australia is totally prohibited.

Co-operative Companies.

A Declaration has been issued under "*The Primary Producers' Co-operative Associations Act of* 1923," declaring the following companies to carry on operations of a co-operative nature in relation to primary produce:—

(1) The Maryborough Co-operative Dairy Co., Ltd., Maryborough.
(2) Wide Bay Co-operative Dairy Co., Ltd., Gympie.
(3) Kin Kin Co-operative Dairy Co., Ltd., Kin Kin.
(4) The Maleny Co-operative Dairy Co., Ltd., Maleny.
(5) Caboolture Co-operative Co., Ltd., Caboolture.
(6) The South Burnett Co-operative Co., Ltd., Murgon.
(7) Nanango Co-operative Dairy Co., Ltd., Nanango.
(8) The Esk Co-operative Dairy Co., Ltd., Esk.
(9) The Terror's Creek and Samson Vale Co-operative Dairy Co., Ltd., Dayboro'.
(10) The Downs Co-operative Dairy Co., Ltd., Toowoomba.
(11) Roma Co-operative Dairy Co., Ltd., Roma.
(12) The Chinchilla Co-operative Dairy Co., Ltd., Chinchilla.
(13) The Oakey District Co-operative Butter Co., Ltd., Oakey.
(14) Goombungee Co-operative Dairy Co., Ltd., Goombungee.
(15) The Rockhampton District Co-operative Dairy Co., Ltd., Rockhampton.
(16) The Central Queensland Dairyman's Co-operative Co., Ltd., Rockhampton.
(17) The Farmers and Producers' Co-operative Co., Ltd., Rockhampton.
(18) Dawson Valley Co-operative Co., Ltd., Wowan.
(19) The Port Curtis Co-operative Dairy Co., Ltd., Gladstone.
(20) Bundaberg Co-operative Dairy Co., Ltd., Bundaberg.
(21) Gayndah Co-operative Dairy Co., Ltd., Gayndah.
(22) The Warwick Butter and Dairying Co., Ltd., Mill Hill, Warwick.
(23) The Logan and Albert Co-operative Dairy Co., Ltd., Beaudesert.
(24) The Southern Queensland Co-operative Dairy Co., Ltd., Kingston.
(25) The Stanley River Co-operative Co., Ltd., Woodford.
(26) The Queensland Farmers' Co-operative Co., Ltd., Booval.
(27) The Atherton Tableland Co-operative Butter and Bacon Co., Ltd., Atherton.

Regulations passed under "*The Primary Producers' Co-operative Associations Act of* 1923," provide—

(*a*) That every Company registered under "*The Companies Acts,* 1863 *to* 1913," and every society registered under "*The Industrial and Provident Societies Act of* 1920" must, within the period commencing on the 1st February, 1924, and ending on the 30th June, 1924, hold a meeting of its members to decide whether or not such company or society will cease to be registered under the Acts or Act under which it is registered and apply to become registered as an Association under "*The Primary Producers' Co-operative Associations Act of* 1923," and for this purpose alter its rules and constitution in such a manner as will entitle it to be registered as an association under the Act;

(*b*) Each of the companies undermentioned must hold such a meeting on the date specified; and

(*c*) Fixing the penalty for a breach of the Act at an amount not to exceed £20.

(The names of the companies are enumerated above, while the dates of the meetings correspond with the order of the names of the companies):—

Day and date of meeting:—

(1) Tuesday, 12th February, 11 a.m.
(2) Wednesday, 13th February, 1.30 p.m.
(3) Thursday, 14th February, 11 a.m.

(4) Friday, 15th February, 2 p.m.
(5) Saturday, 16th February, 11.30 a.m.
(6) Wednesday, 20th February, 11.15 a.m.
(7) Thursday, 21st February, 11.15 a.m.
(8) Friday, 22nd February, 11.15 a.m.
(9) Saturday, 23rd February, 11.15 a.m.
(10) Tuesday, 4th March, 12 noon.
(11) Wednesday, 5th March, 11.15 a.m.
(12) Thursday, 6th March, 2.30 p.m.
(13) Friday, 7th March, 1.30 p.m.
(14) Saturday, 8th March, 10.45 p.m.
(15) Wednesday, 12th March, 10.30 a.m.
(16) Wednesday, 12th March, 12 noon.
(17) Wednesday, 12th March, 3 p.m.
(18) Thursday, 13th March, 11.15 a.m.
(19) Friday, 14th March, 1.45 p.m.
(20) Wednesday, 19th March, 11.15 a.m.
(21) Friday, 21st March, 11 a.m.
(22) Wednesday, 26th March, 10.30 a.m.
(23) Thursday, 27th March, 11.30 a.m.
(24) Friday, 28th March, 11.15 a.m.
(25) Tuesday, 1st April, 1.15 p.m.
(26) Wednesday, 2nd April, 12 noon.
(27) Wednesday, 16th April, 12 noon.

An Order in Council under "*The Primary Producers' Organisation Acts*, 1922 *to* 1923," has been issued revoking a previous Order in Council, and constituting new boundaries for nineteen different districts, for the purposes of the Act.

Swingle-Bars—A Seven-horse Set of Equalisers.

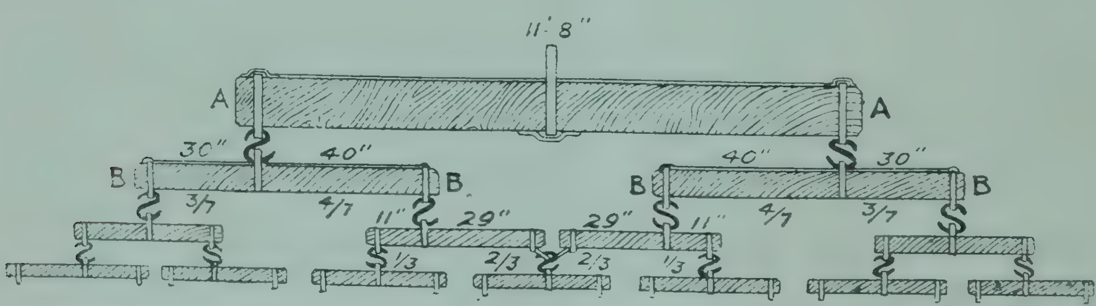
The accompanying illustration sets out the dimensions for a seven-horse set of equalisers, which will be found useful where large teams are utilised:—

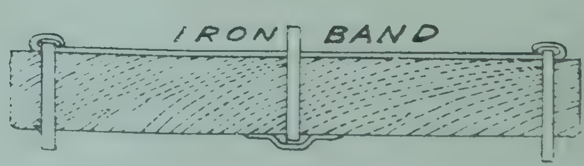
If the swingle-bars are constructed from split instead of sawn timber, and are strengthened in the manner shown in the illustration, they are practically everlasting, provided, of course, that fair usage is given.

Old buggy tyres, especially those known as "half-round," form excellent material for strengthening bands, whilst the rest of the fittings are quite within the scope of the handy man who can weld a piece of iron and make an S hook.

As will be noticed, this set has an added recommendation by reason of the fact that the centre set of three-horse equalisers could be used separately by the addition of a "king bar," and two two-horse sets are also available, and can be similarly converted into a four-horse set.

For ordinary use, single-horse bars should measure a clear 27 inches between the points of draught, with a total length of bar overall of 30 inches.—A. E. GIBSON, Instructor in Agriculture.





Forthcoming Shows.

The Queensland Chamber of Agricultural Societies has supplied the following list of show dates for 1924:—

Stanthorpe: 6th to 8th February.
Warwick: 13th to 15th February.
Goombungee: 6th March.
Pittsworth: 12th March.
Killarney: 19th and 20th March.
Toowoomba: 25th to 27th March.
Royal National Fat Steer Show: 29th March.
Dalby: 2nd and 3rd April.
Chinchilla: 8th and 9th April.
Nanango: 3rd and 4th April.
South Brisbane: 5th April.
Wallumbilla: 15th and 16th April.
Clifton: 16th and 17th April.
Herberton, 21st and 22nd April.
Oakey: 24th April.
Maleny: 23rd and 24th April.
Goondiwindi: 29th and 30th April.
Taroom: 6th and 7th May.
Blackall: 6th and 7th May.
Toogoolawah: 7th and 8th May.
Wondai: 8th and 9th May.
Boonah: 14th and 15th May.
Springsure: 14th and 15th May.
Murgon: 15th and 16th May.
Kilkivan: 21st and 22nd May.
Ipswich: 21st to 23rd May.
Emerald: 21st and 22nd May.
Beaudesert: 28th and 29th May.
Marburg: 2nd and 3rd June.
Esk: 4th and 5th June.
Maryborough: 3rd to 6th June.
Childers: 10th and 11th June.
Bundaberg: 12th to 14th June.
Pine Rivers: 13th and 14th June.
Lowood: 20th and 21st June.
Rockhampton: 24th, 26th, 27th, and 28th June.
Mackay: 3rd to 5th July.
Kilcoy: 3rd and 4th July.
Biggenden: 3rd and 4th July.
Bowen: 9th and 10th July.
Caboolture: 17th and 18th July.
Sunnybank: 19th July.
Barcaldine: 22nd and 23rd July.
Rosewood: 23rd and 24th July.
Ithaca: 25th and 26th July.
Nambour: 30th and 31st July.
Mount Gravatt: 2nd August.
Humpybong: 7th August.
Royal National: 11th to 16th August.
Gympie: 20th and 21st August.
Belmont: 23rd August.
Imbil: 27th and 28th August.
Crow's Nest: 4th September.
Wynnum: 6th September.
Beenleigh: 11th and 12th September.
Zillmere: 13th September.
Stephens: 20th September.
Rocklea: 27th September.
Southport: 10th October.

Answers to Correspondents.

Mangosteen Tree (*Garcinia xanthochymus*).

L.W. (Cairns)—

The Government Botanist (Mr. C. White, F.L.S.) advises that the mangosteen referred to is *Garcinia xanthochymus*, a native of India. It is cultivated in a few gardens in North Queensland, but is not common. Its fruit is not of much value, but the tree is worthy of cultivation for its interest and beauty. It propagates very readily from seed.

Matchbox Beans (*Entada scandens*).

There is no great existing demand for matchbox beans. Any Brisbane nurseryman will supply information as to disposal.

Rhodes Grass.

A.T. (Toowoomba)—

Rhodes grass grown on rather poor soil near Brisbane was compared with locally-procured good-looking samples of chaff. Analyses showed that practically double the value of protein contents was present in Rhodes grass as compared with the oaten and wheaten chaff. An analysis of samples of Sudan grass grown at Gatton College and Hermitage State Farm also showed protein content considerably higher than that of oaten or wheaten chaff. For Results *see* next page.

RESULTS.

—	Moisture.	Crude Protein.	True Protein.	Carbohydrates.	Crude Fibre.	Crude Fat.	Digestible.				Nutritive Ratio, 1.	Starch Value.	Lb. Fodder to Give.	
							Protein.	Carbo-hydrates.	Fibre.	Fat.			Starch equivalent to 11 lb. Starch.	Protein equivalent to 1·9 lb. Protein.
	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Rhodes grass, young growth, 2nd cut	9·41	15·02	8·76	29·60	32·50	1·20	5·00	18·92	19·50	·63	8·0	44·4	25	38
Rhodes grass, 2½ months' old, just flowering	12·82	12·41	6·98	33·25	28·82	1·00	3·98	21·25	17·28	·53	10·0	43·3	25	48
Rhodes grass, 3½ months' old, full flower	10·44	11·10	6·26	33·53	33·53	1·03	3·57	21·41	20·08	·54	12·0	45·9	24	53
Wheaten chaff	10·27	5·83	4·23	44·20	32·20	1·06	2·41	28·30	19·30	·56	20·3	51·1	21	79
Oaten chaff	10·64	4·39	3·97	47·50	29·05	2·12	2·26	30·40	17·42	1·12	22·3	52·4	21	85
Sudan grass from Gatton College (dried)	10·73	8·47	5·69	41·40	28·38	0·71	..	..	..	..	..	..	..	..
Sudan grass from Hermitage State Farm (dried)	8·86	12·35	6·91	44·76	23·73	1·04	..	..	..	..	11·2	47·6	23·1	48·2

Orchard Notes for March.

THE COASTAL DISTRICTS.

As soon as the weather is favourable, all orchards, plantations, and vineyards that have been allowed to get somewhat out of hand during the rainy season should be cleaned up, and the ground brought into a good state of tilth so as to enable it to retain the necessary moisture for the proper development of trees or plants. As the wet season is frequently followed by dry autumn weather, this attention is important.

Banana plantations must be kept free from weeds, and suckering must be rigorously carried out, as there is no greater cause of injury to a banana plantation than neglect to cultivate. Good strong suckers will give good bunches of good fruit, whereas a lot of weedy overcrowded suckers will only give small bunches of undersized fruit that is hard to dispose of, even at a low price.

The cooler weather will tend to improve the carrying qualities of the fruit, but care must still be taken to see that it is not allowed to become overdeveloped before it is packed, otherwise it may arrive at its destination in an overripe and consequently unsaleable condition. The greatest care should be taken in grading and packing fruit. Only one size of fruit of even quality must be packed. Smaller or inferior fruit must never be packed with good large fruit, but must always be packed separately as required by regulation.

The marketing of the main crop of pineapples, both for canning and the fresh fruit trade, will be completed in the course of the month, and as soon as the fruit is disposed of plantations which are apt to become somewhat dirty during the gathering of the crop must be cleaned up. All weeds must be destroyed, and if blady grass has got hold anywhere it must be eradicated, even though a number of pineapple plants have to be sacrificed, for once a plantation becomes infested with this weed it takes possession and soon kills the crop. In addition to destroying all weed growth, the land should be well worked and brought into a state of thorough tilth.

In the Central and Northern districts, early varieties of the main crop of citrus fruits will ripen towards the end of the month. They will not be fully coloured, but they can be marketed as soon as they have developed sufficient sugar to be palatable; they should not be gathered whilst still sour and green. Citrus fruits of all kinds require the most careful handling, as a bruised fruit is a spoilt fruit, and is very liable to speck or rot. The fungus that causes specking cannot injure any fruit unless the skin is first injured. Fruit with perfect skin will eventually shrivel, but will not speck. Specking or blue mould can therefore be guarded against by the exercise of great care in handling and packing. At the same time, some fruit is always liable to become injured, either by mechanical means, such as thorn pricks, wind action, hail, punctures by sucking insects, fruit flies, the spotted peach moth, or gnawing insects injuring the skin. Any one of these injuries makes it easy for the spores of the fungus to enter the fruit and germinate. All such fruit must therefore be gathered and destroyed, and so minimise the risk of infection. When specked fruit is allowed to lie about in the orchard or to hang on the trees, or when it is left in the packing sheds, it is a constant source of danger, as millions of spores are produced by it. These spores are carried by the wind in every direction, and are ready to establish themselves whenever they come in contact with any fruit into which they can penetrate. Specking is accountable for a large percentage of loss frequently experienced in sending citrus fruits to the Southern States, especially early in the season, and as it can be largely prevented by the exercise of necessary care and attention, growers are urged not to neglect these important measures.

Fruit must be carefully graded for size and colour, and only one size of fruit of one quality should be packed in one case. The flat bushel-case (long packer) commonly used for citrus fruits, does not lend itself to up-to-date methods of grading and packing, and we have yet to find a better case than the American orange case recommended by the writer when he came to this country from California in 1892, and which has again proved its superiority in the recent shipments of oranges from the Southern States to England. Failing this case, a bushel-case suggested by the New

South Wales Department of Agriculture is, in the writer's opinion, the most suitable for citrus fruits, and were it adopted it would be a simple matter to standardise the grades of our citrus fruit, as has been done in respect to apples packed in the standard bushel-case used generally for apples throughout the Commonwealth. The inside measurements of the case suggested are 18 in. long, 11¾ in. wide, and 10½ in. deep. This case has a capacity of 2,200 cubic inches but is not included in the schedule of the regulations under "*The Fruit Cases Acts*, 1912-1922." The half-bushel case, No. 6 of the Schedule above referred to, is 10 in. by 11¾ in. by 5¼ in. inside measurements with a capacity of 1,100 cubic inches. The case should be suitable for oranges and the half-case for mandarins. No matter which case is used, the fruit must be sweated for seven days before it is sent to the southern markets, in order to determine what fruit has been attacked by fruit fly, and also to enable bruised or injured fruit liable to speck to be removed prior to despatch.

Fruit fly must be systematically fought in all orchards, for if this important work is neglected there is always a very great risk of this pest causing serious loss to citrus growers.

The spotted peach-moth frequently causes serious loss, especially in the case of navels. It can be treated in a similar manner to the codlin moth of pip fruit, by spraying with arsenate of lead, but an even better remedy is not to grow any corn or other crop that harbours this pest in or near the orchard. Large sucking-moths also damage the ripening fruit. They are easily attracted by very ripe bananas or by a water-melon cut in pieces, and can be caught or destroyed by a flare or torch when feeding on these trap fruits. If this method of destruction is followed up for a few nights, the moth will soon be thinned out.

Strawberry planting can be continued during the month, and the advice given in last month's notes still holds good. Remember that no crop gives a better return for extra care and attention in the preparation of the land and for generous manuring than the strawberry.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

The advice given in these notes for the last few months regarding the handling, grading, and packing of fruit should still be carefully followed. The later varieties of apples and other fruits are much better keepers than earlier-ripening sorts, and as they can be sent to comparatively distant markets, the necessity for very careful grading and packing is, if anything, greater than it is in the case of fruit sent to nearby markets for immediate consumption. Instruction in the most up-to-date methods of grading and packing fruit is being given in the Granite Belt area during the present season by Mr. Rowlands, the Fruit Packing Expert, whose practical advice and instruction should enable the growers in that district to market their produce in a much more attractive form.

The same care is necessary in the packing of grapes, and it is pleasing to note that some growers are packing their fruit very well. Those who are not so expert cannot do better than follow the methods of the most successful packers.

Parrots are frequently very troublesome in the orchards at this time of the year, especially if there is a shortage of their natural food. So far, there is no very satisfactory method of combating them, as they are very difficult to scare, and, though shooting reduces their numbers considerably, they are so numerous that it is only a subsidiary means.

As soon as the crop of fruit has been disposed of, the orchard should be cleaned up, and the land worked. If this is done, many of the fruit-fly pupæ that are in the soil will be exposed to destruction in large numbers by birds, or by ants and other insects. If the ground is not worked and is covered with weed growth, there is little chance of the pupæ being destroyed.

Where citrus trees show signs of requiring water, they should be given an irrigation during the month, but if the fruit is well developed and approaching the ripening state, it is not advisable to do more than keep the ground in a thorough state of tilth, unless the trees are suffering badly, as too much water is apt to produce a large, puffy fruit of poor quality and a bad shipper. A light irrigation is therefore all that is necessary in this case, especially if the orchard has been given the attention recommended in these notes from month to month.

Farm Notes for March.

Land on which it is intended to plant winter cereals should be in a forward stage of preparation. Sowings of lucerne may be made at the latter end of the month on land which is free from weed growth and has been previously well prepared.

The March-April planting season has much in its favour, not the least of which is that weeds will not make such vigorous growth during the next few months, and, as a consequence, the young lucerne plants will have an excellent opportunity of becoming well established.

Potato crops should be showing above ground, and should be well cultivated to keep the surface soil in good condition; also to destroy any weed growth.

In districts where blight has previously existed, or where there is the slightest possible chance of its appearing, preventive methods should be adopted—*i.e.*, spraying with "Burgundy mixture"—when the plants are a few inches high and have formed the leaves; to be followed by a second, and, if necessary, a third spraying before the flowering stage is reached.

Maize crops which have fully ripened should be picked as soon as possible and the ears stored in well-ventilated corn cribs, or barns. Selected grain which is intended for future seed supplies should be well fumigated for twenty-four hours and subsequently aerated and stored in air tight containers. Weevils are usually very prevalent in the field at this time of the year and do considerable damage to the grain when in the husk.

The following crops for pig feed may be sown:—Mangel, sugar beet, turnips and swedes, rape, field cabbage, and carrots. Owing to the small nature of the seeds, the land should be worked up to a fine tilth before planting, and should contain ample moisture in the surface soil to ensure a good germination. Particular attention should be paid to all weed growth during the early stages of growth of the young plants.

As regular supplies of succulent fodder are essentials of success in dairying operations, consideration should be given to a definite cropping system throughout the autumn and winter, and to the preparation and manuring of the land well in advance of the periods allotted for the successive sowings of seed.

The early planted cotton crops should be now ready for picking. This should not be done while there is any moisture on the bolls, either from showers or dew. Packed cotton showing any trace of dampness should be exposed to the sun for a few hours on tarpaulins, bag or hessian sheets, before storage in bulk or bagging or baling for ginning. Sowings of prairie grass and *phalaris bulbosa* (Toowoomba canary grass) may be made this month. Both are excellent winter grasses. Prairie grass does particularly well on scrub soil.

Dairymen who have maize crops which were too far advanced to benefit by the recent rains, and which show no promise of returning satisfactory yields of grain, would be well advised to convert these into ensilage to be used for winter feed. This, especially when fed in conjunction with lucerne or cowpea, is a valuable fodder. Where crops of Soudan grass, sorghum, white panicum, Japanese millet, and liberty millet have reached a suitable stage for converting into ensilage, it will be found that this method of conserving them has much to recommend it. Stacking with a framework of poles, and well weighting the fodder, is necessary for best results. All stacks should be protected from rain by topping off with a good covering of bush hay built to a full eave and held in position by means of weighted wires.

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON, F.R.A.S.

TIMES OF SUNRISE AND SUNSET.

AT WARWICK.

1924.	JANUARY.		FEBRUARY.		MARCH.	
Date.	Rises.	Sets.	Rises.	Sets.	Rises.	Sets.
1	5·1	6·49	5·25	6·46	5·46	6·23
2	5·2	6·50	5·26	6·46	5·47	6·22
3	5·3	6·50	5·27	6·45	5·47	6·21
4	5·3	6·50	5·28	6·44	5·48	6 20
5	5·4	6·50	5·29	6·43	5·48	6·19
6	5·5	6·51	5·30	6·43	5·49	6·17
7	5·5	6·51	5·30	6·42	5·49	6·16
8	5·6	6·51	5·31	6·41	5·50	6·15
9	5·6	6·51	5·32	6·40	5·50	6·14
10	5·7	6·51	5·33	6·39	5·51	6·13
11	5·8	6·51	5 33	6·39	5·51	6·12
12	5·9	6·51	5·34	6·38	5·52	6·11
13	5·10	6·51	5 35	6·38	5·53	6·10
14	5·11	6·51	5·36	6·37	5·54	6 9
15	5·12	6·51	5·36	6·36	5·54	6·7
16	5·12	6·51	5·37	6·35	5·55	6·6
17	5·13	6·51	5·38	6·35	5·56	6·5
18	5·14	6 50	5·38	6·34	5·56	6·4
19	5·15	6·50	5·39	6·33	5·57	6·3
20	5·16	6 50	5·40	6·32	5·57	6 2
21	5·16	6·50	5·40	6·32	5·58	6 0
22	5·17	6 50	5·41	6·31	5·58	5·59
23	5·18	6·49	5·41	6·30	5·59	5·58
24	5·19	6·49	5·42	6·29	5·59	5·57
25	5·20	6·49	5 42	6·28	6·0	5·56
26	5·20	6·48	5·43	6·27	6·0	5 55
27	5·21	6·48	5 44	6·26	6·1	5·53
28	5·22	6·47	5 45	6·25	6·1	5·52
29	5·23	6·47	5·45	6·24	6·2	5 51
30	5·24	6·46	...	...	6·2	5·50
31	5·25	6·46	...	...	6·3	5·49

PHASES OF THE MOON, OCCULTATIONS, &c.

The times stated are for Queensland, New South Wales, Victoria, and Tasmania, when "Summer" Time is not used.

6	Jan.	●	New Moon	10 48 p.m.
14	,,	☾	First Quarter	8 45 a.m.
22	,,	○	Full Moon	10 57 a.m.
29	,,	☽	Last Quarter	3 53 p.m.

Perigee 4th Jan., at 8·12 p.m.
Apogee 16th Jan., at 2·42 p.m.

On 1st January, at midday, the earth was 3,000,000 miles nearer to the sun than it will be on 3rd July at 11 p.m. Mercury will be at inferior conjunction with the sun on the 13th at 2 p.m. The moon will pass above the planet Neptune on the 24th at 7 p.m., at an apparent distance of about three times its diameter.

5	Feb.	●	New Moon	11 38 a.m.
13	,,	☾	First Quarter	6 9 a.m.
21	,,	○	Full Moon	2 7 a.m.
27	,,	☽	Last Quarter	11 15 p.m.

Apogee 13th Feb., at 11·42 p.m.
Perigee 26th Feb., at 1·54 a.m.

The planets Venus and Uranus will be apparently remarkably close to one another on 1st February, Venus being the uppermost. On the 5th Mercury will be at its greatest elongation west of the sun at a distance of 25½ degrees. Neptune will be at its highest position about midnight on the 9th. Mars and Jupiter will seem to be remarkably close to one another on the 14th at about 3 a.m. There will be a total eclipse of the moon in the early hours of 21st February, when the moon will enter the earth's umbra or darker shadow a little after midnight. It will be totally eclipsed between about 1·20 a.m. and 2·57 a.m., and will leave the umbra about 4 a.m.

6	Mar.	●	New Moon	1 59 a.m.
14	,,	☾	First Quarter	2 50 a.m.
21	,,	○	Full Moon	2 30 p.m.
28	,,	☽	Last Quarter	6 24 a.m.

Apogee 12th March at 7·54 a.m.
Perigee 24th March at 3·12 a.m.

On 5th March a partial eclipse of the sun will be visible in parts of South America and South Africa, but not in Australia. The planet Uranus will be in conjunction with the sun, which will pass between the earth and Uranus, on the 8th at 6 p.m. Jupiter will be at quadrature with the sun on the 9th at midnight. Being west of the sun, it will be visible from about midnight to dawn.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S., add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhere about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

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QUEENSLAND AGRICULTURAL JOURNAL

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Event and Comment.

The Current Issue.

The cultivation of tobacco is fully dealt with in this issue. The matter published is also available to tobacco growers in pamphlet form. The present position of "Bunchy Top" investigations is fully described in a comprehensive report by Dr. Darnell-Smith. The Northern Instructor in Agriculture, Mr. N. A. R. Pollock, supplies some useful notes on the cultivation of winter greenfeeds in his territory. The work of the Stock Experiment Stations at Yeerongpilly and Townsville for the past year is also reviewed. Mr. Shelton's subject this month is the Poland-China breed of pigs. Included among other useful features is an informative note on a new cotton pest by Mr. Simmonds, B.Sc., of the entomological staff. Pressure on space in this month's Journal has compelled the holding over for the next issue of much other useful matter, including the regular sugar field reports, a valuable report on fruit fly investigations in the Stanthorpe district, tables and appendices supplementary to Mr. Eklund's notes on irrigation in Queensland, and abstracts and reviews.

Sheep on the Northern Tablelands.

In an interesting report to the Minister (Hon. W. N. Gillies) Mr. W. G. Brown, Instructor in Sheep and Wool, discusses the practicability of sheep-raising on the Atherton and Evelyn Tablelands. Mr. Brown, after a close observation of local conditions, lectured to farmers in the several Tableland centres on the possibilities of sheep-farming in localities in which hitherto comparatively little attention has been given to the industry. Sheep-raising on the northern highlands is, of course, not a new idea. Several settlers have been successfully running flocks there for periods varying from seven to thirteen years. Tableland farmers generally have evinced a keen interest in the prospect of adding yet another profitable side line to their enterprise. The dingo pest is the only really serious difficulty in the way, its presence making night-yarding a necessity. Existing flocks on the Tablelands are strong and healthy, but their numbers are insufficient to supply the local mutton demand. Sheep for the local meat market have now to be brought all the way from the Hughenden pastures, and the long journey by rail and steamer is against their being delivered in prime condition. Local sheep slaughtered by Mr. Brown showed no signs of worms or disease and the mutton was excellent. Not much attention has, however, been given to breeding a high type, but local flocks might be improved

in a comparatively short time by introducing good blood from Southern studs. If most farmers kept a small flock, fifty animals, say, the Tableland settlements could easily supply the whole of the Northern mutton trade. The land there is of the best, with a rainfall up to 70 inches per annum, and Mr. Brown declares that most of the country he inspected on his recent tour of duty has a carrying capacity of five ewes to the acre. The Northern Tablelands generally are, he considers, good districts for farmers' sheep. In Queensland there is none better.

The Romance of Wool.

The extraordinary world wide demand for wool, a demand reflected in the "record" values at the last Brisbane wool sales, naturally increases interest in sheep as a profitable side line on small holdings. Scarcely any phase of Australian development can compare with the success that has attended sheep-breeding. Wool has largely made Australia what she is to-day and wool still ranks as our greatest wealth-winner. The story of Australian pastoral development is full of romance. Early in our history Australian wool won world-wide fame, to-day it passes through the looms of every nation, and our sale rooms echo a babel of voices in fiercest competition from every country. The story is no mere record of success imposed upon success, or of an easy journey along a straight unrutted road; it is a story of courage, triumph over difficulties, and the exercise of all that is great in national character.

Sheep on Small Holdings.

The present wool position naturally suggests closer attention to the possibilities of sheep-raising on the farm. All countries have been forced to face the problem of how to profitably use high-priced land after the hunting and pastoral stages have been passed. Queensland is now confronted with this problem in respect to country within, say, 150 miles of the seaboard. In Britain the problem was settled generations ago. Every A.I.F. man interested in animal husbandry who had an opportunity of seeing rural England was amazed at the number of stock carried on her pastures. In Scotland and Ireland similar conditions obtained. Every farm seemed to have its flock of sheep. In the aggregate there are now something like 24,000,000 sheep in small farmers' flocks in the British Islands. Compared with this number our last available statistics (1923) show that in the whole of Queensland there are depastured no more than 18,000,000 sheep. In Britain 500 is a large flock. Mixed farming is the answer to the question as to the use of high-priced land to the best advantage. Instead of the farmer merely growing produce to cart to market—produce which in bountiful seasons gives only comparatively small returns and in dry seasons is only scantily grown—he will turn his produce into manufactured commodities—butter, cheese, bacon, meat, and wool. These commodities are in world-wide demand. There is a vast accumulated fund of theoretical and practical information upon which to draw, for in all the lands of the older countries generations of "mixed" farmers have left records of their work. Sheep-raising has been practised by them along every conceivable line of breeding and feeding, and this section of animal husbandry has nearly reached perfection. Some of that knowledge has been presented in the Journal from time to time, and so much of it as affects Queensland questions is now available in bulletin form for distribution to farmers who contemplate the establishment of another profitable side line on their holdings.

Handling Small Clips.

The Department of Agriculture and Stock receives and classes farmers' clips from flocks of 1,500 sheep and under. No lot is too small for consideration. One bag or even one fleece is classed according to its grade, and every lot is handled by skilled wool sorters. On delivery at the departmental wool room consignments are weighed and valued. If required, an advance of 60 per cent. on the initial appraisement is sent to the farmer by return mail, the balance being adjusted on market realisation. The advantages to the farmer under this scheme are his obtaining of the best possible service at the minimum rate of commission, 1¼ per cent.; the extremely low classing rate of 10s. per bale; and the reduction of all other charges to a minimum. Without a scheme of this character farmers' small lots would ordinarily have to be offered in unattractive parcels, and low values would consequently rule. The department aims to encourage the keeping of some sheep on every farm on which conditions are suitable, and to obtain the best values for small clips by placing them before the buyer in attractive and even lines. At the last sales in Brisbane farmers' lots marketed under the scheme brought up to 31d. for merino, 31d. for crossbred, and 23½d. for merino pieces, and these results would not have been possible without efficient preparation of the product and its effective presentation on the market.

"BUNCHY TOP" DISEASE IN BANANAS.

BIOLOGIST'S REPORT.

Dr. G. P. Darnell-Smith, Biologist, New South Wales Department of Agriculture, in the following report, summarises recent field observations and states the present position in regard to laboratory work.

Symptoms of the Disease.

Plants affected with bunchy top manifest the disease somewhat suddenly. The first, and, so far as I know, infallible sign of bunchy top is the development of a green streak or streaks upon the under side of the midrib of one of the younger leaves.

Normally the midrib of such a leaf has a particularly even pale-green colour. It is covered with white wax, especially the basal portion, through which the colour may be seen. In a plant about to become bunchy a streak an inch or less in length of a darker green makes its appearance in the midrib. In some cases this is followed by other short green streaks, or by streaks extending nearly the whole length of the midrib. In later stages older leaves will show a number of parallel green streaks on their under side at the point of their attachment to the pseudo-stem. (It is stated by some growers that the irregular distribution of the chlorophyll adjacent to the parallel vein of the leaf, and which has the appearance of green streaks, is a sign of bunchy top; but while such a streaky appearance is often to be seen when the leaf of a bunchy top plant is held up to the light, I have seen a similar streaky appearance in the leaves of plants which have not had a check of any kind, and it is frequently to be noted in the first leaves put forth by plants after their somewhat dormant period during the winter months.) After the appearance of the green streaks abovementioned in the midrib the plant ceases to develop normally. The young leaves do not expand and attain their full size, being a little shorter than normal. They do not spread normally, and assume a position more or less at right angles to the incident light, but point upwards and, as successive leaves develop, the apex of the pseudo-stem appears to become constricted and the leaves to become bunched together. The laminæ of the leaves now become exceedingly brittle, as also does the midrib, and often many of the leaves are markedly ridged. The central leaf now develops abnormally, the particular abnormality depending on the age of the plant. In a healthy plant, say, six months or more old, the central leaf is tightly rolled and has upon its apex a small cap, which remains upon the tightly-rolled leaf until it has attained almost its full length. The cap then withers and the leaf unfolds and expands rapidly. In a bunchy top plant of the same age the cap falls away prematurely, the leaf does not expand rapidly, and in the funnel formed by the partially unfolded leaf water collects. In this stagnant water bacterical action soon gets up putrefaction and the centre of the plant may become a putrid mass. In other cases the constriction and cessation of growth at the apex of the stem prevent the young leaves from developing, although there is pressure from below, and on splitting open such a stem, the tissues of the young leaves will be found to be compressed and distorted. On splitting open the pseudo-stem, in addition to the distortion here described, some scattered brown areas about a quarter of an inch in diameter are to be found in the leaf sheaths. They are somewhat gummy in appearance. Smears from these areas have not revealed bacteria. In young plants the central leaf is tightly rolled and depressed to the upper surface of the midrib of the last leaf to unfold. In a healthy plant it remains in this position for a considerable period, and then unfolds from the apex downwards. In a diseased plant it quickly assumes an upright position and starts to unfurl from the centre. If a plant eighteen months old or more is about to throw a bunch of fruit, this is carried up on the apex of the stem in the centre of the pseudo-stem. In a bunchy top plant this bunch of fruit may fail to get past the constriction at the apex of the pseudo-stem; it may get half out or it may get wholly out. In any case the fruit is short, brittle, and sweet. The bracts subtending the male flowers are uniformly dark-red in colour in a normal plant; in a bunchy top plant they are generally tipped with green and curl backwards to a greater extent than usual.

Healthy banana tissue, both in the corm and pseudo-stem, is almost wholly white when first cut open. If cut with a steel knife a purplish colour will soon appear over the surface. The cut surface of a bunchy top corm develops this colour much more slowly.

A corm in the incipient stages of the disease shows when cut open small ducts of a pale yellow colour, irregularly distributed. These ducts run in every conceivable direction, following the course of the vascular bundles, so that sections may be transverse, longitudinal, or oblique. I am not certain of the exact nature of these ducts; usually there are two, one on each side of a vascular bundle. They may be traced upwards through the corm and out into the base of the pseudo-stem, and they

extend upwards into the leaves. The number of these discoloured ducts increases with the progress of the disease, so also does the intensity of their colour through yellow, red, brown, to black. By the time the colour has become red the contents have become solid, and they frequently have a moniliform appearance. It is to this solidification that the brittleness of the tissue of a bunchy top plant is probably due in part.

The roots originate at the stele, pass through the fleshy cortex and so into the soil. The main roots are fleshy and of uniform diameter throughout. From these, small thread-like roots arise laterally and branch profusely. On the thread-like roots and back of the main root tips are born the root hairs. The roots may extend outwards six feet or more. Upon healthy corms many roots are found that are dead and decayed, so that the occurrence of dead roots would appear to have little significance. In a bunchy top plant in an advanced stage of the disease practically all the roots are dead to within three inches or so of the corm, and in many cases the decayed root tissue traverses the cortex as far as the stele. The xylem vessels are often brown, brown patches are found in the cortex of the roots, and a variety of organisms, including *Fusaria,* are found just inside the decayed ends.

Two species of eelworms have been found in the roots of bananas on the Tweed. The banana bettle borer "*Cosmopolites sordidus*" is widely distributed, and a beetle, which the Entomologist has identified as *Gonocephalum Mastersi,* was found gnawing the corms. Except as possibly exposing the root or the corms to infection, these do not appear to have any relation to the cause of bunchy top. An examination of numbers of preparations taken under aseptic conditions by means of forceps and scalpel, or by boring solid corms with a cork borer and taking the centre of the corms from plants in an advanced stage of bunchy top, has convinced me that these plants have to a large extent lost their immunity and that secondary invasions have taken place. The cause of bunchy top must be sought in healthy suckers planted in a bunchy top infected area and examined immediately the first signs of the disease present themselves. These suckers must be obtained in the first place from a district where the disease has never been known to occur. Appropriate infection experiments must then be carried out under control conditions, a matter to which I will refer later. Suffice it to say for the present that until this month these control conditions have not been available.

I have made a comparison of healthy and diseased roots. In a healthy root the primary meristem occupies only a very small portion behind the root cap and is very tender. The roots have little power of threading their way around obstacles; the root tip dies when it meets a boulder and a lateral is formed. Healthy roots grow rapidly, their tips and the young part of the root are creamy-white in colour, numerous laterals are produced which are also creamy-white in colour, they appear to function for a short time only, when they die and become dark-brown or bluish-black. The surface of the older parts of the main root may be brown or purplish in colour. The roots of a bunchy top plant often have greyish-coloured tips and grey-coloured laterals; these latter are often of a purple hue and many patches of epidermal cells, bright blue in colour, are frequently to be found upon them. The root hairs are frequently open at their ends and full of organisms having the appearance of minute micrococci. Zooglacal formations of a brilliant blue colour are also to be found on the surface of the roots, and the epidermal cells in contact with them become blue.

Observations which Suggest that the Cause of Bunchy Top is to be Found in the Roots or in the Corm.

A healthy corm and a diseased corm were kept in slowly running water for a fortnight. The development of white roots upon the healthy corm was very rapid. The development of roots upon the unhealthy corm was slow; they assumed a grey colour with blue patches in places. On planting this corm in the soil it developed three perfectly healthy leaves and then reverted to the bunchy top condition.

A heap of discarded healthy suckers from Queensland was observed in the Tweed River district. They had been thrown in the shade and had remained there some time. Some of the corms had developed surface roots, white and healthy looking, and they had also thrown up young and healthy looking stems and leaves. At my request the grower planted them. In three months he reported that they had developed bunchy top.

The experience of nearly all planters is that when an area of ground is planted to bananas some of these turn bunchy. If these are removed and fresh corms planted in the same or adjacent holes these also become bunchy.

While bunchy top may make its appearance upon plants widely separated in a plantation, usually the plants round about or adjacent to the ones first showing signs of disease are the next to follow.

Bunchy top corms kept under observation give one the impression that the plant is trying to form roots and is unable to do so. Those at the base of the corm usually decay first, then those immediately above. When these decay fresh roots are formed nearer the stem base; these in turn succumb, and are followed by others smaller and more insignificant arising almost from the stem base itself.

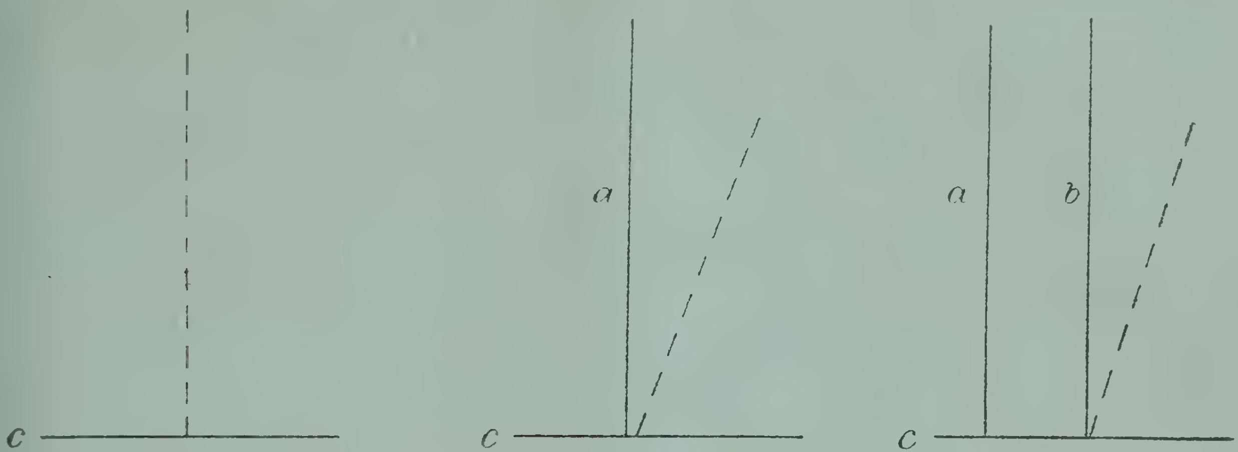
A diseased plant was kept for a year in a pot surrounded by six healthy plants; none of these latter became bunchy.

Two healthy (?) plants have been under observation in pots for two years. Quite recently they have turned bunchy.

These observations suggest: (1) Fungus or bacterial infection of the root or corm; (2) that the infecting organism may act as a saprophyte or a parasite. They are in accord with the sporadic occurrence of the disease.

These suggestions are supported by the history of the disease in the field. When an area is newly planted, generally only a few of the corms turn bunchy within the first eighteen months. At this period they throw a bunch of fruit, and it is after this "first cut" that a large number usually turn bunchy. At the end of the third or fourth year the disease is generally widespread.

Diagrammatically the position may be represented thus: the dotted lines represent a Bunchy Top plant.



Bunchy 1st Year.
c.—Ground level.

Bunchy 2nd Year.
a.—Old healthy stem of 1st Year.
c.—Ground level.

Bunchy 3rd Year.
a.—Old healthy stem of 1st Year.
b.—Old healthy stem of 2nd Year.
c.—Ground level

The first figure indicates the condition that a few plants attain in the first year, the second figure indicates the condition of a large number of plants in the second year, the third figure indicates the condition of a very large number of plants in the third year.

In pruning bananas the unwanted suckers are removed with a sharp spade or an iron bar. Where the sucker is prized off the parent a large surface is left on the parent or on the sucker through which, if the disease is due to a soil organism, entry could be made. As already indicated, I suspect a soil organism attacking the roots or the corm or both.

Banana Sap.

The sap of a healthy banana is of a pale yellow colour shortly after it is collected. On the corm it soon sets to a dark yellow jelly, which hardens. When examined after being freshly drawn it consists of a transparent serum in which are suspended innumerable globules of a viscid nature which do not coalesce. They give the freshly drawn sap a milky appearance. As the sap coagulates irregular linear solid bodies make their appearance. The sap of a diseased banana is light-red in colour and sets on the corm to a dark brown solid. Under the microscope the appearance is the same as that of healthy sap. In setting, it appears to deposit a greater amount of crystalline substances, but no quantitative estimate has been made. No trypnosones have been observed in the sap. A quantity of sap can easily be obtained by scooping out the centre of a large corm until a saucer-shaped cavity is formed. The saps collects in the cavity. On one occasion some shoots of mallow were placed in this diseased sap, the leaves became blotched in a short space of time, and all the shoots drooped. The phenomenon may have been due to osmosis.

Whilst suspecting a soil organism as the cause of the disease, I picture its action as causing development of a toxin, so that in diseased tissues we shall have toxic sap, and from healthy tissues healthy sap, until with the progress of the disease the accumulation of toxic sap over-balances the healthy sap and we get the development of bunchy top.

A bunchy top plant will frequently throw suckers which remain healthy in appearance for a considerable time. Nevertheless, if removed and planted they invariably turn bunchy top eventually. Locally the disease is said to be hereditary. Internal and external micro-organisms may, of course, be transferred unconsciously.

Digging out Diseased Corms.

It is the usual recommendation and practice when a plant becomes bunchy top to dig it out and let it lie where dug; often it is split open and chopped up in order that it may dry more readily in the sun. To burn it would be a better practice, but sufficient wood is not available. The general consensus of opinion among growers is that this practice stays the onset of the disease sufficiently to give them one bunch of fruit more than where it is not adopted. It may actually aid in spreading the disease, since any soil organisms attached to the roots might be more easily dispersed by the wind. Exposure to the sun, however, may kill them. A number of thoroughly air-dried bunchy top corms were heaped around a healthy plant growing in a pot. After a year the plant so treated remains healthy.

Distribution of the Disease.

At the present time I should regard the whole of the Tweed area as infected. Areas of infection also occur in the Richmond River district. There is little doubt but that the disease was spread considerably by the use of diseased suckers before anything as to its nature was known. I am of opinion that no plant in the Tweed district can be regarded as free from disease, even though it may appear perfectly healthy. I have had two "healthy suckers" from the Tweed district which were grown in pots in Sydney turn bunchy top after two years. These "healthy" plants on the Tweed may have developed a certain amount of resistance. At any rate they do not apparently succumb so rapidly to the disease as many suckers imported from a part of Queensland said to be free from bunchy top. If the casual organism is a soil organism, in addition to its spread upon implements, boots, and the hoofs of horses, there is no difficulty in accounting for its spread by the wind. Most of the plantations are situated at considerable altitudes. In dry weather the soil attains a very dusty condition. Weeds grow rapidly in the district, and are generally kept in check by continual chipping with a hoe. If chipping is carried out during dry, windy weather, clouds of dust are carried for miles.

Possibility of Insects Transmitting or Causing the Disease.

Pressure has been placed upon the Government from time to time to offer a reward for the discovery of a cure for bunchy top. The offering of a reward for such a purpose I have strenuously opposed unless the onus of proof were on the claimant. Otherwise every recommendation, however manifestly absurd, must be tested out by Government officials, with great resultant loss in time and money.

In 1922, Mr. J. Marks, of Terranora, announced that he had discovered the cause and cure of bunchy top. He wanted £5,000 to disclose his secret, and a deputation waited on the Minister to urge the payment of this sum or a large contribution towards it. The deputation, members of a local committee which had viewed a new plantation of Mr. Marks, were so impressed with its freedom from bunchy top that they felt justified in urging the Government to contribute to the payment of the sum claimed by Mr. Marks for the disclosure of his secret.

At the request of the committee to the Minister, I was permitted, in conjunction with Mr. Symington, of the Department of Agriculture, to aid them in drawing up an agreement with Mr. Marks. Briefly, the agreement was thus:—

(*a*) A sum of £5,000 (to which the Government might consider making a contribution) was to be raised by a small levy upon every case of bananas leaving the district.

(*b*) This sum to be paid to Mr. Marks at the end of two years if he were successful with the following test:—

(*c*) One hundred healthy banana-suckers selected from any healthy area by Mr. Marks were to be planted in soil where banana plants had previously succumbed to bunchy top. Mr. Marks, adopting any means he liked, was to keep 95 per cent. of these free from bunchy top for two years.

(*d*) He was to disclose his secret in order that others might test his process.

(*e*) A check plot of 100 healthy plants was to be planted adjacent to the experiment plot. These were to receive no treatment of any kind.

Mr. Marks agreed, and was so sure of his remedy that he guaranteed to keep not 95 per cent. but 100 per cent. of the plants healthy. Three months after the commencement of the experiment one of the plants went bunchy and he lost his £5,000. I immediately wrote to Mr. Marks asking him to continue his trial. This he did. The results are given below. The experiment was carried out at Mr. Sutton's plantation at Terranora. Mr. Marks announced: (1) That bunchy top was due to aphides which attacked the plants; (2) that if no aphides were allowed to attack the plants no bunchy top would develop; (3) that the aphides could be kept in check sufficiently to prevent bunchy top by spraying at intervals with kerosene emulsion.

The previous history of the plot in which the test was carried out was: (1) It bore bananas for five years and then went out with bunchy top; (2) it was replanted with local bulbs, these went out with bunchy top practically within a year, only about 12 per cent. remaining healthy.

Mr. Marks' plot was planted 9th November, 1922. It was sprayed 19th December, 1922, 4th January, 1923, 17th January, 1923, 1st February, 1923, 15th February, 1923, 5th March, 1923, 12th March, 1923, 21st March, 1923, 3rd April, 1923, 18th April, 1923, and three times since. Three sacks of lime were broadcasted over the plot before planting. Each stool received a dressing of 1 lb. sulphate potash and ½ lb. nitrate of soda. The first bunchy top plant made its appearance on 17th January, 1923. I inspected the plot on 16th January, 1924. Twenty stools were completely bunchy and two more had unhealthy suckers.

The 100 plants in the check plot were put in on the 9th November, 1922. Fifty of them have had 1 cwt. lime and 1 cwt. basic super. applied to them broadcast. I inspected these on 16th January, 1924. Twenty-six stools were bunchy. The remaining 50 plants had no lime and no manure. I inspected these on the 16th January, 1924. Thirty-nine plants were bunchy. The progress of the disease in this plot was—

9th November, 1922	planted
17th January, 1923	7 bunchy
25th February, 1923	22 ,,
16th January, 1924	39 ,,

The comparison between Mr. Marks' treated plot and the check plot on 16th January, 1924,—*i.e.*, thirteen months after planting, was—

Check plot	65 plants were bunchy
Treated plot	20 ,, ,, ,,

The Government ran a check plot of 100 healthy plants against that of Mr. Marks at Mr. Tierney's plantation at Barney's Point; they were to be sprayed with kerosene emulsion on the same dates and in the same manner that Mr. Marks sprayed. Some of the plants were to be sprayed with nicotine sulphate instead of kerosene emulsion. This work was carried out by Mr. Bartlett, an officer of the Department. Mr. Bartlett's conduct was not entirely satisfactory, and he left the Department in June, 1923. On 28th April, 1923, he submitted a report in which he stated that out of 60 plants sprayed with black leaf 40 had turned bunchy, and that 8 plants out of 100 in the experiment parallel with that of Mr. Marks (spraying with kerosene emulsion and liming) had turned bunchy. I visited these plots on 24th January, 1924. Mr. Tierney stated that one after another of the plants had turned bunchy, and that those that remained healthy had shown such poor growth that he had decided to plough the land and plant sugar-cane. This he had done, leaving only a few of the most vigorous and healthy plants.

Other growers have tried spraying with kerosene emulsion. One of those who sprayed most consistently was Mr. Craven of Mullumbimby. I inspected his plantation in December, 1923. His plantation is on a hillside where there is a spring of water, so that the difficulty of water carriage is not present. On the 18th December, 1922, he planted 2,100 plants 7 ft. by 7 ft. apart, the suckers being derived from an old plantation showing a fair amount of bunchy top. He rejected 515 plants within one month for various reasons, and then replaced them. He sprayed every two weeks till the end of March. In May, about 50 plants showed bunchy top. In December, so many plants showed bunchy top that Mr. Craven abandoned the plantation. He had given up spraying some six months before. For the first few months after planting and during the earlier period of spraying the plants made remarkable growth.

When it was first suggested that aphides were the cause of bunchy top, I took two healthy plants that I had had growing in pots for eighteen months. A supply of aphides upon bunchy tops from the Tweed River district was procured, and the aphides were allowed to crawl off the unhealthy on to the healthy plants. Some were transferred by brushing them on with a camel hair brush. The aphides multiplied rapidly. A month later another batch of aphides from a bunchy top plant from the

Tweed River district was transferred to the plant. The aphides multiplied rapidly, and many of the leaves were covered with them. At the end of three months the plants began to look unhealthy but showed no signs of bunchy top. Gradually the plants died down and withered completely.

Thinking that perhaps these plants were too mature, aphides from a bunchy top plant have been transferred to a young Queensland plant that has just commenced to grow. The aphides have multiplied rapidly; they have been upon the plant for a month and are still under observation. So far the plant has shown a faint brown discoloration on the stem but no signs of bunchy top. This experiment will need to be repeated upon other plants.

I have made a number of observations upon the banana aphis (*Pentalonia nigronervosa*) in the field. They are to be found widely distributed both upon healthy and bunchy top plants. They are most numerous in wet weather, and their numbers diminish rapidly in dry weather. They inhabit chiefly the young leaves, just as they are unfolding, and the spaces between the sheath of the outer leaves and the pseudo-stem. They creep down into the ground for a considerable distance. They congregate upon the apices of young suckers before they have emerged from the ground.

Since a connection has been established between the leaf-roll disease of potatoes and aphides the banana aphis must still be under suspicion as a possible factor in the development of bunchy top.

If aphides are shown to be either the cause or the carriers of the disease I am of opinion that their control will not be accomplished by means of either a kerosene or a nicotine spray, because (1) the only aphides that are destroyed are those that come into actual contact with the spray, (2) in the positions which they occupy between the sheathing leaves and the pseudo-stem an air cushion, which it is impossible to penetrate, is formed as soon as spraying commences, (3) large numbers of them live underground, (4) very few plantations have any water near to them, (5) the constant spraying necessary to keep the aphides in check would make the labour cost excessive.

Effect of Kerosene Emulsion.

The sheathing basis of banana leaves that have been sprayed with kerosene emulsion fall away from the pseudo-stem in a marked manner, the angle subtended being very much greater than is the case in a normal plant.

In regard to the fact that at present the treated plot is more free from bunchy top than the untreated plot, the suggestion is hazarded that the constant watering has resulted in a preponderance of healthy roots, and that kerosene emulsion promotes root growth. (Some preliminary experiments that I carried out a few years ago upon quite another matter suggested this view.)

The banana aphis was first described in 1859, and is described by Froggatt in the "Agricultural Gazette," N.S.W., April, 1923.

Dust Treatment.

At the time that Mr. Marks' experiment was commenced, another grower refused to take delivery of 103 Queensland suckers. These were eventually obtained by Mr. Sutton after they had been exposed to the weather for two months. The scar caused by cutting would by this time have healed over. (This is noteworthy in connection with the possibility of a pathogene gaining entrance through a freshly cut surface.) All the original suckers died after being planted, and new corms were formed. The plants as they grew were dusted every two months with sulphur, so also was the ground around the plants and the sulphur raked in. One pound of sulphur was used per 100 plants. The previous history of the plot was (1) It had borne bananas for five years, which all eventually went out with bunchy top, (2) it was replanted with bananas which went out with bunchy top in the course of twelve months. I inspected this plot on the 16th January, 1924. Four plants only at this time had turned bunchy. A week later I was informed on the most reliable authority that two more plants had turned bunchy. The plants in this plot have made comparatively poor growth. Their future history may be carefully watched.

Mr. Wells, of Mullumbimby, planted 4 acres 7 ft. by 7ft. in December, 1922. His plants were selected from 4 acres of bananas which were going rapidly bunchy. The bulbs were dipped in kerosene emulsion before planting. He sprayed three times after the planting. He then started dusting his plants with sulphur and later with sulphur to which a little Paris green had been added. In his case the cartage of water to his plantation for spraying involved such an amount of labour

that he abandoned it and sought to find a deterrent. He claims that the mixture used has diminished the extent of the attack by aphides. They may have diminished from quite another cause—viz., the prolonged drought from which the North Coast suffered towards the end of 1923. I inspected his plantation in December, 1923. A number of his plants had turned bunchy.

Some plants upon Mr. Sutton's plantation, the soil around which was dusted with Bordaux mixture every two months, remained healthy longer than others but eventually succumbed.

Other Experiments.

Mr. Brooks, of Highfield, a few years ago announced that bunchy top could be cured by placing sulphur around the plants and chipping it into the soil. He and many others tried this method and eventually abandoned it..

Mr. Brooks then carried out the following experiment. Trenches were made by ploughing in such a manner as to throw up the soil upon either side until a deep V-shaped trench was obtained. This was then liberally manured with basic super.; the banana plants were set in the trench and the soil replaced and heaped around the corms. In this loose soil roots developed freely but the plants eventually turned bunchy.

There being some evidence that bunchy top originated by a rot setting up at the cut surface of a corm, Mr. Brooks has removed a number of suckers from apparently healthy plants, originally obtained from Queensland and now growing in the plot where the experiment with basic super. was carried out. Each of these corms has been smeared over the cut surface with Stockholm tar and planted. I inspected these plants in January, 1924; it is too early to report upon the experiment.

Mr. Brown, of Barney's Point, has carried out a number of experiments. His plantation has been kept absolutely free from weeds and has been well manured. Various manures have been tried, as also has liming, but the plantation is going out with bunchy top. He claims to have produced bunchy top by inoculating a plant with acetic acid. He now has a plot which he has treated with ammonium carbonate. The plot has not been under treatment sufficiently long to give any definite results. I visited Mr. Brown's plantation in January, 1924.

Of the various bunchy top cures claimed by Messrs. Clarke, Alioth, Selkirk, and others I have not seen any lasting results. It will often happen that a treated plant receives some sort of stimulus to which it reacts for a short period.

Manurial Treatments.

The Department has tried the following manures:—

1. 10 oz. super.;
   1 lb. blood.
2. 16 oz. potash;
   1¼ lb. super.;
   2 lb. blood.
3. 2 lb. potash;
   2½ lb. super.;
   4 lb. blood.
4. 1¼ lb. am. sulph.;
   1¼ lb. super.;
   1 lb. potash.
5. 1½ lb. blood;
   ¾ lb. am. sulph.;
   1¾ lb. super.
6. 2 lb. blood;
   1½ lb. super.
7. 2 lb. potash.

These were applied to rows of plants twice a year over a period of two and a-half years. They were tried at Mr. Radcliffe's plantation, Barney's Point (poor soil), Mr. Sutton's plantation, Terranora (medium soil), Mr. Pilgrim's plantation, Tweed Heads (good soil). They appeared to have no influence upon the incidence of bunchy top, which made its appearance here and there throughout the treated rows indiscriminately, and the majority of the plants

eventually went out with bunchy top just as if they had received no treatment. The manured plants bore more heavily than those that were unmanured, and the best results at the price appeared to be given by No. 4. It was not possible with the limited assistance available to get a comparison of yields; the fact that bananas may throw bunches at any period of the year renders this particularly difficult.

It is generally agreed that a potash manure is beneficial to bananas, since the following is the composition of the ash:—

	Per cent.
Silica	2.19
Lime	1.82
Iron oxide	0.18
Phosphoric acid	7.68
Magnesia	6.45
Soda	15.11
Potash	43.55
Sulphur trioxide	3.26
Chlorine	7.23

While I have seen no evidence of the application of a manure curing bunchy top, my recommendation to a grower starting a plantation would be to manure from the start in order that he might reap the maximum yield.

Mr. Deane, of Coraki, adopted this procedure. He ploughed his land, applied 15 cwt. of lime per acre, added 3 cwt. of Shirley's Banana Manure per acre, and then planted. I inspected the plantation in January, 1924. In spite of the drought of the latter part of 1923 the growth of the plants in fourteen months has been stupendous. A few are showing bunchy top.

I have treated two bunchy top plants in pots with the following mixture over a period of four months, and have not observed the slightest response:—

Potassium nitrate	2 parts
Sodium chloride	1 "
Calcium sulphate	1 "
Magnesium sulphate	1 "
Calcium phosphate	1 "

I am of opinion that a bunchy top plant is almost incapable of responding to a manure.

Laboratory Work.

Any pathologist investigating a new disease finds himself at once at a dead end unless he can test out the pathogenicity of a suspected organism. This has been my position.

Any organism regarded as being the cause of a disease must conform to the following well-known canons: (1) It must always be found associated with the disease, (2) it must be isolated in pure culture, (3) it must reproduce the disease upon inoculation into healthy subjects, (4) it must be again isolated from these in pure culture..

Only by having plants under control conditions in a glass house can suitable experiments on the lines indicated be carried out. I have frequently urged the necessity of being provided with such equipment and placed my views on the matter before the Select Committee on the Agricultural Industry in 1921. They reported, *inter alia*:—

> "The provision of several plant houses (glass houses) suitably heated with half an acre of land attached is recommended. This is the most urgent and pressing need of the biologist. He has no place in which to grow plants under pot culture conditions, where he can make the exact observations that are necessary in effective research. While a large sum is being spent annually on demonstration farms, this exceedingly important item in the work of research has not yet been provided. It seems obvious that when the State employs the services of scientific men to advise and to undertake investigation it should provide the pre-requisites for that work in the shape of equipment. Much of the work that the Biological Branch undertakes has to stop short at the very stage where culture work and microscopic investigation has revealed the desirability of proceeding further with infection experiments upon living plants under control in pots. To leave a botanist and plant pathologist unprovided with resources in this direction severely handicaps his work and retards progress. It is a penny-wise-and-pound-foolish policy which should be promptly remedied. (Final Report from the Select Committee on the Agricutural Industry, 191, p. 205.)"

I am happy to be able to report that a glass house 40 ft. by 18 ft. has now been erected in the Botanic Gardens for the use of the Biological Branch. It was completed in January, 1924. Adjacent is a shed where a steriliser, in which large pots filled with soil can be sterilised, has been fitted up and a small room where preliminary observations with a microscope can be made. I particularly suspect *Fusaria* and bacteria attacking the roots. Several organisms have been isolated. It is hoped to make fresh isolations from plants that have just turned bunchy, and to use mass inoculations of these organisms while they are in a virile condition and not weakened by sub-culturing. Two dozen healthy plants from Queensland are growing ready for experimental work; more will be obtained. I have not been able to convince myself after examining a large number of specimens that the internal tissues of the corm, stem, or leaves of a bunchy top plant are infected by bacteria or fungi as casual organisms. Those found have varied, indicating that they are secondary invaders. In advanced stages in wet weather even *Coprinus* sp. and *Myxomycetes* may be found upon bunchy top plants. Hence the necessity of examining plants that have just turned bunchy and obtaining material for experimental work from them. I propose to experiment with material obtained from the roots of these first. Bags of soil from an area badly infected with bunchy top and from an area slightly infected with bunchy top have been obtained. By filling pots with these and sterilising them and planting in them healthy bananas, and at the same time planting bananas in unsterilised soil in pots, it should be possible to determine whether or not infection arises from the soil.

Question of Dealing with Unprofitable Plantations.

There is a certain similarity between bunchy top and Panama disease. The microscopic symptoms of Panama disease—viz., dwarfing, wilting, sudden yellowing of the leaves, fracture of the leaves, and splitting of the pseudo-stem are quite different from those of bunchy top, but the appearance of the cross section of the corms of old diseased plants suffering from Panama disease given by Brandes (Banana Wilt. Phytopathology, Vol. IX., No. 9, p. 339) are identical with the appearance of old diseased corms of plants suffering from bunchy top. The roots in both cases are short and black. Brandes speaks of the ''discoloured vascular bundles'' in the corm, though from his description I should gather that he is really referring to the ''ducts'' filled with brown material to which I have previously referred. The figures which he gives of these discoloured vascular bundles which appear here and there in cross section of the pseudo-stem again represent exactly the discolorations to be observed in the vascular areas in cross sections of the stem of bunchy top plants. Panama disease was shown by Brandes to be due to *Fusarium cubense.*

He says that in regard to the prevention of the disease ''Steam sterilisation was very effective, but it is needless to say that under present conditions this method is impracticable. Disinfection of the soil in small plots by drenching with copper sulphate, carbolineum, and formaldehyde was not only unsuccessful but the expense prohibitive. Other attempts to eradicate or render innocuous the parasite in the soil were worse than useless.''

In Jamaica, the profitable life of a banana plantation is regarded as being about five years. Unfortunately, in the Tweed district it has been assumed that it would be much longer. Many plantations in the Tweed district have gone out with bunchy top, and it may be impossible to find a remedy as in the case of Panama disease. The problem presents itself—What is to be done with the land for which a high price has been paid? Tomatoes, passion vines, and beans (though very liable to black spot disease) may be grown and find a ready sale at high prices in Sydney early in the season, but later they meet the competition of fruit grown much nearer to the city. The completion of the Murwillumbah to Sydney line and the running of a fruit train has put the district nearer to Sydney by forty-eight hours than it was before, and there will be much money in early beans. The great desideratum in regard to passion fruit is a means of preserving the juice at full flavour and free from pips. People are so afraid of appendicitis that I doubt if a really large overseas trade could be worked up unless the extraction of the pips were accomplished. Sugar-cane could be grown on the land, but the Colonial Sugar Company will not buy cane unless it can be moved on barges or upon temporary rails on account of the cost of handling. Most of the banana plantations could not possibly be reached by barge or rail. The establishment of a Government sugar-mill is suggested by some. Some planters would be prepared to cease growing bananas on their plantations and farm elsewhere till the ground has had a rest or a remedy has been discovered for bunchy top. But if the ground is left fallow it will become covered with paspalum. Owing to the stony nature of the soil and its configuration, this will become absolutely ineradicable. It has been suggested that such abandoned plantations should be planted temporarily to lantana.

The question of dealing with land which has ceased to grow bananas profitably is one upon which some recommendations would be appreciated by growers.

Drought Effects.

A partial drought on the North Coast will often cause a check to the growth of a banana plant. If this occurs one or two months before a plant is about to throw a bunch, the plant being to a certain extent constricted at the apex, the rising bunch will be held fast. The true stem below the bunch continues to elongate, with the result that it becomes bent; in extreme cases it becomes S-shaped.

A prolonged drought occurred during the latter part of 1923. The effect upon some bunchy top plants was remarkable. Around some of the stools apparently healthy suckers sprang up when rain came, and I observed some bunchy top plants that had actually thrown three healthy leaves. In one case suckers were observed arising from the base of an old bunchy top corm that had been lying on the ground; these had formed surface roots, and although still attached to the parent, appeared perfectly normal. The drought would affect (1) A great diminution in the number of aphides, (2) a partial soil sterilisation.

Other Banana Diseases.

Anthracnose (*Cloeosporium* sp.), corm rots (where a corm has been planted immediately over the decaying root of an old tree stump or has been attacked possibly by *Armillaria melea*), and rust (due to thrips) have no apparent connection with bunchy top.

Occurrence of Bunchy Top in other Countries.

In October, 1921, Dr. Bryce (then in Ceylon, now Director of Agriculture in New Guinea) published a leaflet (Leaflet 18, Dept. of Agriculture, Ceylon) upon the Bunchy Top Plantain Disease. He records that the disease first appeared in the Colombo district in 1913 and then gradually spread. It attacked a plot of Manilla hemp in 1918. He records the disease as occurring in Fiji, Australia, Egypt, and the Bonin Islands. He found *Rhizoctonia* sp. on the roots. A preliminary experiment to determine whether the disease is caused by a filterable virus indicated that it is not so caused. It is stated that in the Bonin Islands bunchy top is attributed to deficiency of potash in the soil and that it has been found that application of potash manure greatly reduces the number of bunchy top suckers and even enables transplanted diseased suckers to recover. It is stated that it has been observed in Fiji that the Gros Michel banana is immune.

Dr. Butler, Director of the Imperial Bureau of Mycology, who attended the Pan-Pacific Conference, and who formed one of a party of which I was a member that visited the Tweed River district, has kindly sent to me an early report upon a disease that attacked bananas in Fiji and did much damage. From the description given there seems little doubt but that the disease referred to is bunchy top. If so, this disease appeared in Fiji in 1879. Dr. Bryce states that the plantain industry in Fiji was practically destroyed by bunchy top disease between 1890 and 1900. Bunchy top disease is present in Fiji at the present time. Mr. Beddoes, a Fijian planter, informs me that he has dealt successfully with it by (1) Ploughing out the corms and ploughing the land with a 28-inch. disc plough, (2) liming, (3) planting to some other crop for a year or more, (4) replanting with bananas. (*Note.*—Ploughing with any sort of plough is out of the question on a large number of the plantations in the Tweed River district on account of the configuration of the land and its stony nature).

Immune Varieties.

The principal variety grown in the Tweed River district is the Cavendish. I have seen other varieties (whether correctly named or not I cannot say) attacked by bunchy top. These are known locally as ''Ladies' Fingers,'' ''Gros Michel,'' and a banana from the Island of Moa.

A Mr. Sands, of Queensland, has lately stated that he has an immune variety of banana, the Vernon. Numbers of these have this season been purchased and planted in the Tweed River district. Partly because the beetle borer occurs in the Queensland district where they are grown and partly to supply the demand from a few plants, eyes rather than corms have been supplied to growers. The pared surfaces should offer an ideal area for the entry of a soil organism, and the plants reputedly immune will therefore be subject to a severe test. In January, 1924, I obtained two of these suckers from the plantation of Mr. Bentley, at Barney's Point, which had been planted in November, 1923. These plants were undoubtedly suffering from bunchy top disease when I obtained them.

Mr. Beddoes informed me that there was a variety reputedly immune grown in Fiji known as the "Middle Banana" or Vi-mia-mia. The Department may attempt to import a few of these suckers, taking suitable precautions to prevent the introduction of disease.

A variety, the Hansonian banana, reputedly immune, is being grown in the Tweed district this season. I have no particulars concerning it at present.

In any bunchy top plantation some plants will remain growing fairly vigorously long after others, and though affected will continue to throw small buches. Continuous selection from such plants is a method of evolving an immune variety that is worthy of trial.

G. P. DARNELL-SMITH, Biologist.

11th February, 1924.

YEERONGPILLY STOCK EXPERIMENT STATION.

A YEAR'S ACTIVITIES.

C. J. POUND, Government Bacteriologist.

Abstracted from the Annual Report of the Under Secretary for Agriculture and Stock (Mr. Ernest G. E. Scriven) to the Minister (Hon. W. N. Gillies) for presentation to Parliament.

Immunisation of Stud Cattle for Tick Fever.

In the course of the past year a total of 69 stud cattle were received to be immunised against tick fever. These animals comprised different breeds of bulls, cows, and heifers.

These animals all reacted satisfactorily to the inoculation of recovered blood, and there were no deaths.

Some of the animals were so susceptible that they reacted to a single inoculation, while others showed such a marked resistance that they had to be inoculated a second time, and in several cases a third time, before they responded. This clearly explains that the so-called mild and strong blood theory is a misnomer, for blood drawn at one time from a single animal (bleeder), when injected, in some animals produced a very severe reaction with high temperature and hæmaglobinuria, while in others a very slight or no reaction whatever was produced.

Pleuro-pneumonia and the Supply of Natural Virus.

This disease has apparently not been very prevalent during the past year, and in consequence the demand for pleuro virus was not very great. However, preserved natural virus was supplied for the inoculation of 8,910 head of cattle distributed in the following districts:—Mitchell, Morven, Charlevlle, Chinchilla, Augathella, Taroom, Warra, Fernvale, Kilkivan, Duaringa, Eidsvold, Helidon, Laidley, Toowoomba, Macalister, Longreach, Miriam Vale, Boonah, Murgon, Esk, Greenmount, Woodhill, Cooyar, Kilcoy, and Bowen.

All virus supplied is from natural cases of pleuro-pneumonia, and before distribution must have passed a microscopical examination to ensure its freedom from tubercle bacilli, septic bacteria, or any contaminating micro-organisms.

Notwithstanding that the pleuro virus supplied is free from septic bacteria, complaints are occasionally received that some of the animals inoculated suffer from bad tails. This is due to the fact that in these cases no precautions are taken to cleanse and disinfect the skin of that part of the tail operated on. The most satisfactory method of preparing the skin is to remove the hair with a pair of scissors, wash with warm soap and water, disinfect with 1-160 hycol, and finally, after an interval of about two minutes, remove the hycol solution by rinsing with water that has been previously boiled.

Very little extra time is involved in this work, particularly as the animals are operated on in a crush which holds ten or more animals, therefore, after the tail of the last animal in the crush is disinfected, the tail of the first animal is ready to be rinsed with water and inoculated. If these precautions are adopted, together with the use of sterile setons supplied by this laboratory, no "bad tails" should follow.

Supply of Blackleg Vaccine.

During the year 1,690 double doses of blackleg vaccine were supplied to stock owners, distributed principally in the following districts:—Beaudesert, Gleneagle, Coomera, Eudlo, Laidley, Kingaroy, Eumundi, Beerwah, Brooloo, Murgon, Beerooren, Yeulba, Bell, Mooloolah, Morayfield, Kumbia, Harrisville, Gatton Crawford, Miriam Vale, Ipswich, and Gympie.

The vaccine prepared at this laboratory is of a uniform quality, and its reliability is proved by the fact that experimental animals, treated according to directions with a sample of each specially prepared vaccine, withstand the severe test of being subsequently inoculated with virulent blackleg bacilli and spores, while the inoculation of the same germs into control or unprotected animals causes their death in from three to five days.

Contagious Mammitis in Cattle.

This serious disease is continually being brought under notice through outbreaks occurring on dairy farms and the number of specimens of suspected milk being submitted for examination. The spread of this disease is attributed partly to the carelessness of the dairy farmer, who is not alive to its seriousness, or to the hygienic methods of controlling it.

The disease is a catarrhal affection, and limited in most cases to the delicate mucous membrane lining the milk-ducts of the mammary gland, and as a rule there is very little heat or swelling, moreover, the affected parts are not particularly painful.

The disease is caused by a tiny chain-forming micro-organism or streptococcus which attacks the mucous membrane, and, through the generation of its poisonous products or toxins, causes a rapid destruction of tissue-cells and leucocytes or white blood-cells which are attracted to the spot. These dead cells produce that peculiar feature of the disease, a yellowish purulent discharge or pus, which can be withdrawn from the affected quarter.

A specially stained specimen of the deposit examined under the microscope reveals masses of pus-cells with the characteristic streptococci.

In the acute form, the first symptoms of the trouble are a diminution of the milk-yield, a definite acidity of the milk, and a tendency for it to become rapidly coagulated. Gradually the milk assumes a dirty brownish colour and becomes more curdly, the amount of secretion from the affected quarter diminishing owing to the thickening of the ducts, which finally become impervious, and the whole quarter is rendered useless. It will be observed in some cases that the symptoms are so very slight that the milk does not appear to be curdled, and, on settling, the deposit is so small as to be overlooked.

In all cases where slight infection is suspected, a sample of cream as well as the first-drawn milk should be submitted for bacteriological examination.

Undoubtedly the transmission of the infection from cow to cow is through the agency of the milker's hands or the cups of the milking machine. This appliance, which was designed to enable the farmer to produce cleaner milk than by any other method, must be kept scrupulously clean, and be sterilised after each milking, and this advice is also applicable to the hands of the milker; moreover, all cows that are considered in any way suspicious should be milked last.

Once the disease has occurred in a herd, the owner should personally examine minutely every cow's udder before milking, and carefully note the character of the first small quantity of milk drawn. This precaution is especially necessary where a milking machine is in use, and any cow showing the slightest suspicion of disease should be held over to the last for milking, and on no account should the machine be used on her.

Treatment.—The injection of 6 oz. of a warm solution of 4 per cent. pure boracic acid through the teat into the udder immediately after milking is usually recommended for treatment. The solution should be injected at about blood heat, and allowed to remain in the udder for about ten minutes, during which time a gentle but thorough massage of the quarter is conducted, following which the fluid is withdrawn. This treatment should be applied twice daily for from three to five days, and then discontinued.

This method is only satisfactory in the very early stages of the disease, as during the first few days the streptococci are located practically solely on the surface of the mucous membrane, and have not penetrated far into the finer tubes which ramify throughout the delicate substance of the mammary gland. Gradually,

however, the germs penetrate deeper into the tissues and become englobed by cells and push further and further into the narrowing tubules. In this way it becomes impossible for any disinfectant fluid injected into the udder to reach the invading germs. Moreover, it will be remembered that the tissues of the udder are so extremely delicate that a poison sufficiently powerful to immediately destroy the streptococci is also liable to injure the tissue-cells.

The Use of Vaccine.—Both preventive and curative treatment has been carried out successfully by means of specially prepared vaccine. During the past year samples of milk were received from fifty-six cases of suspected contagious mammitis, and in forty-two cases the streptococci were detected by microscopical examination. Further, in each case the micro-organism was isolated, grown artificially in sterile broth, and an autogenous vaccine prepared and supplied to the respective applicants.

The vaccine is prepared by sterilising at a very low temperature (60 deg. C.) a flask containing an active young broth-culture of streptococci. An estimate is made of the bacterial count of the contents, which are then diluted so that each cubic centimeter contains 360,000,000 cocci and 0.5 per cent. trikresol added as a preservative. The standard dose each is 2 c.c. of the diluted vaccine, which is injected into the loose cellular tissue behind the shoulder, and repeated until some improvement is noticeable. Generally two or three injections are sufficient. In cases of emergency a stock vaccine is supplied, but the results are not always satisfactory, the greatest success being obtained by the injection of an autogenous vaccine—*i.e.*, one specially prepared from the organism causing the outbreak.

Practically every stock-owner who has had experience with vaccine prepared at this laboratory speaks of its efficiency most eulogistically.

Notes on Contagious Abortion.

It is most important, when an animal aborts, to determine if possible whether the abortion is infectious. Authorities agree that there are no symptoms by which this fact can be determined with accuracy, although the history of the case may be helpful in making a diagnosis. By means of an agglutination blood-test, the nature of the abortion or the presence of infection in the herd may be determined with a reasonable amount of accuracy.

During the past year, seventy-eight specimens of blood and five of milk taken from suspected cases of contagious abortion were received for the agglutination test. Positive reactions were obtained in twenty cases of blood and one of milk.

It is to be hoped that, as the reliability of the test becomes more generally known, breeders of stud and more particularly dairy stock will avail themselves of the opportunity of forwarding specimens for diagnosis, special attention being given to freshly purchased animals they intend to introduce into their herds.

Exhibits at the Royal National Show.

In the Departmental Court a special exhibit was arranged illustrating some of the many activities of the Stock Experiment Station. This was made up as follows:—

1. A collection of plate and tube cultures with charts, tables, and diagrams descriptive of the many advantages accruing from the use of scrupulously clean methods as compared with slovenly ways on a dairy farm, also the value of condensed or boiled water used in the washing of butter and dairying utensils, and the increased keeping qualities and value of butter made from pasteurised cream.

2. Maps, diagrams, and tables illustrating the method of tick eradication of U.S.A., and pointing out that originally in 1906 the area under quarantine restriction in consequence of the presence on cattle of the Texas fever tick was 728,365 square miles, which included fifteen States, covering the whole southern part of America from the Atlantic to the Pacific Coast.

   So successful has the work been that up to the present time considerably over 500,000 square miles or more than 70 per cent. of the original quarantined area of country has been freed from ticks and released from quarantine restrictions.

3. A collection of laboratory products, viz.—Protective vaccine for blackleg and curative vaccine for contagious mammitis and other diseases of bacterial origin, pleuro virus and sterile setons, lactic cultures, &c.

4. A collection of specially preserved and mounted specimens illustrative of the various manifestations of animal diseases, including tuberculosis of the various organs, glands, and tissue of cattle, pigs, horses, fowls, and turkeys; actinomycosis, showing affection of the jaw, tongue, flank, scrotum, &c.; pleuro-pneumonia, blackleg, swine fever, epithelioma, carcinoma, papilloma, &c.; also a collection of internal and external parasites.

In view of their educational character these exhibits attracted considerable attention, while members of the staff in charge of the exhibit were busily engaged each day answering questions of interested visitors.

Tick Dip Investigation.

During the past year considerable time was devoted to the following investigations conducted under the auspices of the Federal Institute of Science and Industry:—

1. To determine the action of standard arsenical dipping fluids on ticks during the moulting stages.
2. To determine by observation the protective action of arsenical dipping fluid against reinfestation of larval ticks applied to cattle after spraying.
3. To determine the effect of rain on efficacy of treatment with medicament.

The details of these experiments, with the conclusions arrived at, will shortly be published in a bulletin by this institute.

Summarised, these investigations have not demonstrated that improvement has been made on the American method of tick eradication, which insists that, within the area operated on, dipping of all cattle in a standard arsenical solution must be carried out every fourteen days, and be continued without a break until the larval ticks on the ground (which have not succeeded in getting on the cattle) die of starvation.

It has been shown that, after a single dipping, the larval ticks that may subsequently become attached within two days are invariably destroyed, while, of the larval ticks that may become attached three days after dipping, only a very few survive. Some of these die without ovipositing, others oviposit, but the eggs are infertile, while only a small percentage lay eggs which hatch, and the progeny (larval ticks) exhibit a noticeable inactivity.

With fortnightly dipping, the ticks on the treated cattle at the second and all subsequent dippings cannot be more than twelve days old, and therefore, before the second moulting stage, at which period some ticks appear to resist the action of the medicament. There are three reasons why fortnightly dippings have proved successful—

1. Ticks are more readily killed during the earlier stages of their parasitic existence.
2. It can be arranged that dipping day never falls on Saturday, Sunday, or market days, and whatever day is selected will be easy to remember.
3. In the event of wet weather several days remain in which the cattle can be dipped before the ticks drop off.

The New South Wales "Agricultural Gazette" for April, 1923, contains a report by Lionel Cohen, F.C.S., Chemist to the Tick Board of Control, on "Experiments with Arsenical Dipping Fluids."

These experiments deal with the effects of dipping fluids used in various strengths of 4 lb. to 8 lb. of arsenious oxide per 400 gallons of water, some animals being dipped while others were sprayed. The cattle (ordinary dairy cows) were naturally infested, and daily observation made for six days, presumably when they came in to be milked morning and evening.

In the conclusions drawn from the results of the experiments, it states: "The departmental dipping formula contains more arsenic than is required to produce the best results"; and further, "Cattle leaving quarantine might advantageously receive two dippings with a four-day interval in a 5 lb. solution, instead of with a five to ten day interval in an 8 lb. solution."

With a view of confirming the correctness or otherwise of this statement, the following experiment was carried out at Yeerongpilly.

Two naturally tick (moderately) infested cows were procured from a neighbouring farm and sprayed twice with an emulsified solution containing 5 lb. of arsenious oxide per 400 gallons, with four days' interval between each treatment. The animals were kept in stalls under observation for thirty days. Surviving ticks were removed for seventeen days after the second spraying. Of 48 engorged ticks removed, 18 died without ovipositing, 30 oviposited, 13 of which laid eggs which hatched.

This experiment proves that, had these two cows gone into clean country immediately after the second treatment, they could have introduced sufficient active ticks to set up a centre of infestation.

TOWNSVILLE STOCK EXPERIMENT STATION.

A YEAR'S REVIEW.

JOHN LEGG, B.Sc., B.V.Sc., M.R.C.V.S., Director and Government Veterinary Officer.

Abstracted from the Annual Report of the Under Secretary for Agriculture and Stock (Mr. Ernest G. E. Scriven) to the Minister (Hon. W. N. Gillies) for presentation to Parliament.

During the past year visits have been paid into nearly every stock district in connection with outbreaks of contagious diseases amongst stock. It cannot be said that outbreaks of contagious and infectious diseases have been more numerous during the past year, although pleuro-pneumonia contagiosa of cattle has been found just recently in the coastal districts.

Dry conditions prevail everywhere at present, and have been with us for the last twelve months. Recent visits in country districts have indicated that cattle everywhere are in poor condition.

Stock Experiment Station.

The equipment of the Experiment Station has been added to during the last twelve months, and the facilities for working are greatly improved as compared with past years. The station can now undertake the examination of simple bacteriological and pathological material, and sufficient equipment is also available for ordinary chemical analyses.

Immunisation of Cattle against Tick Fever.

During the past year there has been a marked falling-off in the number of cattle received at the station for immunisation against tick fever. Only 34 head were received as against 79 for the previous year, and 191 again for the year previous to that. The mortality for the year has been very high, 7 head of cattle dying. These included five which died of poverty. No deaths were due to redwater. All those cattle which died of poverty were the property of the one owner, and were brought from the South at the end of the dry period of last year. They withstood the redwater inoculation, and it was only some time afterwards that deaths commenced to take place. It was the poorest of the cattle that died, and nearly all had young calves.

Otherwise there was one death (a bull) from traumatic pericarditis, a piece of nail having passed through the reticulum and diaphragm into the thoracic cavity; and one death from fatty degeneration of the heart-muscle.

In the course of the last three years, a total of 328 head of cattle have passed through the Experiment Station. The deaths from redwater reach a total of 6, while deaths from other causes total 13.

In routine inoculation of cattle, interesting points are sometimes brought during the course of a reaction. It is known that all animals do not react exactly alike, either in the type of temperature curve produced, the blood changes which follow, or the time of appearance and disappearance of the casual organisms in the blood.

The reaction largely depends on the susceptibility of the animal concerned. Nevertheless, where animals have been inoculated in numbers, it is found that variations occur in the type of reaction produced, such variations depending upon other factors than the particular susceptibilities of the animals concerned.

The work carried out by the Chemist will be found in the appendix attached. It will be found that there has been a considerable falling-off in the number of dip samples sent in for analysis.

Types of Redwater Reactions.

In vaccinating animals against any contagious or infectious disease, the resultant reactions depend on three factors—the susceptibilities of the animals, the dosage, and the strength of the vaccine. In vaccination against tick fever in cattle, what is really a natural culture of the specific organism is used. Blood containing the organism is withdrawn from an immune animal, a little sodium citrate added to prevent coagulation, and this citrated blood constitutes the vaccine. Within limits, the size of the dose used seems to have no effect on the subsequent reaction, and if a group of animals are inoculated together, with doses of blood, say, varying from 5 to 50 c.c., it is usually found that the resultant reactions are more or less alike.

The strength of the vaccine is an unknown factor. It is usually found that the reaction produced by one immune animal's blood is much the same as that produced by the blood of another immune animal, though it cannot be denied that a survey of the records of a large number of animals inoculated frequently reveals the fact that most of the deaths will be found to follow the use of blood from one or two particular animals.

It is possible, of course, that, by a coincidence, the blood of one or two particular immune animals has been used on the most susceptible animals, but this factor tends to be ruled out when a large number are considered.

Apart from the above variations, all of which might be met with in routine inoculation, there is another variation which sometimes occurs. This is best illustrated by the following two series of inoculations, both samples of blood used being from the same animal (Bleeder B), though drawn at periods of nearly two years apart:—

FIRST SERIES.

Date Inoculated, 21-6-21.

Animal Number.	Result.	Remarks.
	Number of days between Inoculation and appearance of Organisms in Blood.	
47	8	Typical reactions in all cases.
48	8	
49	8	
50	9	
51	9	

SECOND SERIES.

Date Inoculated, 18-4-23.

Animal Number.	Result.	Remarks.
338	Organisms absent	Reinoculated 9-5-23 with blood of D.
339	Ditto	
340	Ditto	Reinoculated 9-5-23 with blood of G.
341	Ditto	
342	Ditto	Reinoculated 9-5-23, 10c.c. blood from H.
343	33rd day after inoculation, organisms absent	
344	Organisms absent	

The first five bulls inoculated in 1921 all passed through typical redwater reactions, the temperature rising anywhere between the sixth and tenth days, the organisms appearing about the same time and remaining in the blood a few days, then the temperature subsiding and the organisms disappearing also.

The second series of animals show quite a marked difference. There was a rise in temperature in all cases about the usual time, and the organisms failed to appear in the blood and had made no appearance twenty-one days after inoculation. In conformity with the usual custom practised here, animals which have not reacted, or those which have reacted doubtfully—and these being considered doubtful—are reinoculated with the blood of a second immune animal twenty-one days after the first inoculation. Nos. 338 and 339 were reinoculated with blood of D, Nos. 340 and 341 with blood of G, and Nos. 342, 343, and 344 with blood of H. For the seven following days the animals were run in the paddock, where they showed no signs of illness, and then smears and temperatures were recommenced.

Every one of these animals on the twenty-eighth day after the first inoculation, and seven days after the second, showed marked blood changes, far more than are usually found following inoculation for redwater. Granular basophilia, nucleated red corpuscles, anisocytosis, and polychromasia were all very marked.

The blood showed all these features, while in addition No. 343 showed numerous piroplasms as well. How are these changes to be accounted for? The second series of inoculations are complicated by the fact that a second inoculation had been carried out in each case, but it is thought that the occurrence of organisms in the blood of No. 343, and the blood changes in the whole five, were most likely due to the first inoculation and not to the second. The argument in favour of this is that blood changes do not usually commence after so short a period as seven days, while on the other hand organisms may be sometimes found weeks after inoculation. Even were it contended that the marked blood changes occurring in the blood of these animals were consequent on the second inoculation, the result is equally remarkable. It rarely happens that marked blood changes occur so often as a week after inoculation at any time, and with the blood of any immune animal, while here were a whole series all showing these blood changes.

The two series represent two different types of reaction, the first being the most frequent, therefore, perhaps, the typical, where the temperature reaction coincides with the appearance of the organisms (7-14th day), the second atypical, where the temperature reaction does not coincide with the appearance of organisms in the blood, but is followed some weeks later by marked blood changes and may be then the appearance of piroplasms.

Since these two series were inoculated with blood from the same animal, it follows that there had been between the dates mentioned some alteration or change in the virulence of the blood of Bleeder B. Whether this change was a result of the animal being kept free from ticks over by far the greater period of time between the dates mentioned, or whether this change in virulency depended on the age of the animal, it is impossibleto say. Perhaps both factors operated.

Pleuro-Pneumonia Contagiosa of Cattle.

A note is made here in connection with this disease, firstly, because of its prominence in the North, and, secondly, because of the many erroneous ideas which exist, both regarding the means by which this disease is spread, and the means of inoculation used in its suppression.

The disease in North Queensland shows little tendency to assume the epizootic form. It exists as an enzootic. Outbreaks are, as a rule, associated with the appearance of a few acute cases, and an equal or larger number of chronic cases, while the majority of animals do not seem to be affected. That the majority of cattle are not affected is borne out by abattoir inspection.

The insidious nature of the disease makes it very difficult to deal with, and the difficulty is further enhanced by the failure of some stock-owners to report the occurrence of the disease in their stock, particularly in those cases where only a few head are lost. What frequently happens is that an owner kills an animal in the acute stage of the disease, draws off sufficient pleuritic fluid to inoculate his herd, and that is all that is done. The consequence is that usually the acutely affected animals die, while chronic ones remain affected, maybe for months, and then also frequently die or appear to recover. It is these chronic cases, or the so-called recovered animals, that are such a serious factor in the production of fresh outbreaks, particularly as many of these animals appear to be quite healthy. To eradicate the disease under such conditions appears to be almost an impossibility. Quarantine measures which are put into operation during outbreaks of this disease seem to have but little influence in suppressing the trouble among station cattle on the run, but they are of much more value where the disease occurs in mobs of travelling cattle.

The disease is caused by a minute micro-organism which is just within the limits of visibility of the highest powers of the microscope. It spreads from beast to beast by contact. Many stock-owners are still of the opinion that the disease arises spontaneously, and will point to the fact that in the wet years of 1917 and 1918 the disease appeared on many runs where it had not been seen for years, and where there had been no movement of stock on or off the run for some time previosuly. Whether the humidity of the atmosphere facilitates the spread of the disease is unknown, but the fact remains that outbreaks have recently occurred in the coastal region of the North, and these during the driest period on record.

In vaccination against this diesase the usual method employed is to pass a small woollen seton soaked in the pleuritic fluid from an acute case of the disease through the end of the tail. This pleuritic fluid contains the causal organism, and this latter finding a suitable medium in the subcutaneous tissue of the tail, commences to multiply. A swelling results, and in a typical case of the disease reaches the size of an egg, or a little larger, and then disappears. The animal is afterwards found to be immune. It occasionally happens that the swelling passes upwards along the

tail, and if neglected reaches the buttocks. There is then growth of the virus in the subcutaneous tissue of the hind quarter, often followed by gangrene of the part. Death often supervenes as a result of toxæmia, but where this does not occur there there is a sloughing of the part followed by gradual healing. Where the swelling is spreading upwards, if the tail is removed before the buttocks are reached, the animal usually recovers and is found to be immune.

Unless an animal shows any swelling of the tail after inoculation, it can usually be deduced that there has been no reaction, and this is found to occur in many animals, possibly because of the possession of a strong natural immunity.

The insertion through the tail of the seton is usually performed by means of a special needle. One drawback to the use of the seton is that there is usually a small amount of hæmorrage in the area, and this, soaking into the seton, helps to dilute and wash out the organisms. Further, as the wound caused by the insertion of the seton is by no means aseptic—in fact far from it—if the tail is examined a few hours afterwards there is always a serious oozing, and this also helps to remove the few drops of virus in the seton. By far the better method of inoculation is to insert a few drops of virus under the skin at the end of the tail by means of a strong hypodermic syringe, but, as many cannot use a syringe properly, the more simple method of the seton is universal.

One of the most erroneous notions that exists in regard to the vaccination of cattle against this disease is that, where a large percentage of swollen tails occur after inoculation, such is due to the carelessness of the inoculator in injuring one of the bones at the end of the tail. It could only be gross carelessness on the part of the inoculator should such occur, and furthermore, even if the bone is deliberately touched with the needle, as a rule no untoward effects follow. Where a large number of swollen tails occur, it can be assumed that the inoculation has been successful and the animals will afterwards be found to be immune.

Impaction Paralysis of Cattle.

This disease, an account of which appears in the ''Queensland Agricultural Journal'' for May of last year for the first time as far as Queensland is concerned, is found to occur in certain areas in the Charters Towers district. Since then, although no actual cases have been seen in other parts, from accounts which have been received there appears to be little doublt that this condition is in no way confined to the areas where is was first discovered.

The condition is apparently akin to the ''impaction paralysis'' of Victoria, the ''dry bible'' of South Australia, and resembles in some way the ''lamziekte'' of South Africa.

It was held for many years that the ''lamziekte'' of South Africa was probably a form of deficiency disease, and many experiments were formed in an attempt to throw light on the disease from this particular point of view. Similarly, in parts of Australia it was believed by many that the disease was also of the nature of a food deficiency. Recently, work by Theiler in South Africa and by Seddon in Victoria has thrown considerable light on the disease. Their experiments have shown that the disease is in all probability produced as a result of the ingestion of powerful bacterial toxins. These toxins are produced in the carcasses of animals lying dead in the open, and they are introduced into the body of the affected animal as a result of the bone-chewing habit. It is well known that the bone-chewing habit is common—in some cases very common—in areas where the disease is prevalent, and it is because of this habit that the condition has been ascribed to some deficiency in the natural herbage.

All the information that the writer has been able to gather appears in the issue of the journal referred to above, and it seems unnecessary to repeat it here. It was there suggested that, the disease probably being caused as a result of the ingestion of bones, all carcasses on an affected run should be burnt out, and that lime should be supplied in troughs. This has been carried out in one small area, and there appears to be a marked decline in the mortality. On the other hand, it is a big problem to commence burning up all carcasses on a large badly infected run, especially as most cattle stations are now working as short-handed as possible.

As the disease in other parts appears to be the result of ingestion of bacterial toxins, investigation along these lines is required in Queensland.

Dip Concentrates.

Two samples of different proprietary preparations, recognised by the Department, were found to be much below the specifications set out thereon, with regard to the arsenic content.

General Analytical Work.

It was hoped that general analytical work would be performed on the completion of the new laboratory, which has been fully equipped for same, but such has not yet been sanctioned. It should be immediately made known that the chemical analyses of many different products can be carried out in the Townsville Laboratory, and this work, with the collaboration of the Council of Agriculture, should be significant.

Parasites of the Pig.

In the report for 1921-2, the discovery of two nematode parasites was recorded. These were *Necator Americanus* and *Ankylostoma duodenale.*

It is now necessary to place on record the further discovery of two other nematode parasites, both from the stomach of the pig.

It had been frequently noticed by the slaughtering inspector of Townsville (Mr. J. A. Rheuben) that certain pigs at the abattoirs were found to be in poor condition. These pigs were fed under similar conditions to other pigs arriving in prime condition, and there appeared to be no reason for the poverty, until it was discovered that these animals were infected with small nematodes in the stomach and duodenum.

Specimens were collected and forwarded to Dr. Georgina Sweet, Associate Professor of Biology, Melbourne University, who writes that the specimens represent two species of nematodes. They are *Arduenna Strongylina* and *Physocephalus sexalatus.*

The former has been already recorded in Australia, but it is not yet known whether the latter has yet been recorded. Credit for the discovery of these parasites is due to the slaughtering inspector, and if all inspectors could be induced to work so assiduously as this officer there is no doubt that valuable information could be obtained, as officials engaged in slaughtering work are in a unique position in having so much material passing under their eyes.

A NEW COTTON PEST.

BY J. H. SIMMONDS, B.Sc., Entomological Staff.

Investigation following the report of a pest attacking cotton in the Woolooga district showed the insect concerned to be a Chrysomelid beetle, *Rhyparida australis* Boh. (A few specimens of another Chrysomelid, *Geloptera seitula* Lea., were also found on the cotton, but probably played a very minor part in the injury.) This beetle is a fairly common insect to be met with in Queensland, and has been found by Mr. Hacker in large numbers under the bark of Eucalypts. The attack at Woolooga was quite localised, as cotton three-quarters of a mile away was not

PLATE 36.—RHYPARIDA AUSTRALIS.

affected. It is, therefore, to be regarded at present only as a secondary pest, some local conditions having evidently given rise to the production of enormous numbers of the insect which found in the cotton a suitable, though probably unusual, host plant.

Rhyparida australis is a small dark brown to black beetle, 5½ to 6 mm. long, or about 7/32 inch. The margins of the wing covers are parallel at the sides and rounded posterially. The prothorax and head form a bluntly triangular shape. The antennæ are brown, long and filliform and arise just in front of the prominent black eyes. The prothorax is black and is covered with minute punctures visible only with a lens. The wing covers have an irregular and variable black area towards the outer side and a black margin to the inner edge. Between these two runs a longitudinal brown band joining with a lighter brown area round the apex. On the wing covers are regular longitudinal rows of striæ, the punctures forming which are larger than those on the prothorax. The legs are brown, darkening towards the joints.

It was stated that the beetles were not noticed in the field on the 24th December, but were plentiful round the lamp on that night. On the 27th they were in the field in great numbers, more especially on the north and west side working round the edge with fewer towards the centre. In bad parts a plant about 1 ft. high might have as many as twenty to thirty beetles upon it. Plants four to six weeks' old were the first and most severely attacked, and to a less extent some two months old. Plants under three weeks were not attacked, the reason for this not being apparent. The beetles were a serious pest for about a week and then diminished greatly in numbers, perhaps owing to the fact that a cold snap occurred at that time, and also they were disturbed in the process of thinning out the cotton plants.

Damage.

The beetles were able to do a great amount of damage owing to their method of feeding. They eat round the soft outer tissue of stems on leaf stalks, circling the stem perhaps only in a narrow band, but sufficient to ringbark the lateral shoot or leaf and cause it to wilt, hang down, and die. Little damage is due to the consuming of the leaf itself. In bad cases the plants are defoliated entirely, only the main stem being left and dying, while in other cases, though practically defoliated, the plant is able to send out new lateral shoots. In larger plants, which had been more or less cut back, bare stumps project which would otherwise be lateral branches, and the terminal shoot is usually destroyed. To replace those lost new lateral shoots grow from the main stem at the base of the cut-off branches. The stems and leaf stalks show erosions. The effect is to give the plant a ragged and deformed appearance as well as a severe setback in growth. Recent damage is seen in the form of a lateral shoot or leaf wilting and hanging from its stem at the point cinctured by the beetle. In confining its attack more especially to those places mentioned above, this beetle is distinct from *Monolepta rosea* which is essentially a leaf eater.

Habits.

The beetles feed at night. During the heat of the day they rest under the leaves and among the terminal shoots. They have also been found in numbers under loose clods of earth in the ground. They are detrimentally affected by heat, since if they happen to fall on their backs in the sun and are prevented from regaining their feet they will die within a few minutes. The beetles are dislodged from the bush by a sharp jar. They appear to be more easily dislodged and more disposed to flight in the evening than during the day.

Control.

Kerosene flares, such as are used for *Monolepta rosea,* can be used for the destruction of this beetle. In this case flares were tried as soon as the beetles were noticed. Thousands flew to the light and were killed, and probably half the population was thus accounted for. To be most effective, large flares should be used and carried between rows, at the same time beating the bushes on each side to dislodge the beetles which will then be attracted by the light and fly into the flame.

Plate 37.—Recent Damage to Lateral Shoot and possible Leaf Injury.

PLATE 38.—BADLY DAMAGED PLANTS.

PLATE 39.—PLANT SHOWING GROWTH OF NEW TERMINAL AND LATERAL SHOOTS AFTER HAVING BEEN CUT BACK.

BREEDS OF PIGS.

E. J. SHELTON, H.D.A., Instructor in Pig Raising.

This series commenced in the November Journal with an article on the classification of pigs. In the following number the points of the Berkshire were set out; in the January issue the Tamworth was fully described, and last month the characteristics of the Middle Yorkshire breed were noted. In succeeding issues other breeds of pigs and matters of moment to pig raisers generally will be discussed.—Ed. "Q.A.J."

THE POLAND-CHINA—AN UP-TO-DATE AMERICAN TYPE.

Special Note.—In describing this, one of America's leading types of pigs, it must be understood that the reference is to the more recently introduced types, and not to those old spotted types one sees occasionally in different districts here in Queensland. These old types are now out of date in so far as their usefulness for the purpose of stud-breeding is concerned, they are also invariably coarser and less profitable than the types described herein, whilst it is impossible to trace their breeding or to record their pedigrees. On the other hand the modern type of Poland-China is up-to-date in this, as in every other respect.

It would not be correct in view of the above statement to classify our Poland-Chinas as belonging to two special groups or types such as might be referred to as Poland-Chinas and Improved Poland Chinas, but it is correct to state that the Poland-Chinas referred to in this article are a decided improvement on the types of fifty years ago, and it is anticipated now that they will become much more popular as time goes on and breeders generally learn to appreciate their special and valuable qualities more than they have done in the past.

How the Poland-China Originated.

Apart from the several breeds of pigs originating in the British Isles from the old English wild pig crossed on to the Chinese and Neapolitan types, there are

PLATE 40.—A PHOTOGRAPH OF THE OLD AMERICAN RAZOR-BACK SOW, NOT UNLIKE MANY OF THE WILD PIGS OF NORTH WESTERN NEW SOUTH WALES AND QUEENSLAND.

When photographed this Sow was five years old and weighed 150 lbs. live weight.

numerous other breeds and types worthy of note that have been evolved in other parts of the world, and of these the American types are perhaps the most widely known and distributed. Prominent amongst these is the Poland-China, which originated in the Miami Valley, Ohio State, in the counties of Butler, Hamilton, and Warren.

While the improvement of various types of animals was taking place in Great Britain our "Yankee" brethren looked on, took notes, and eventually decided to try if something could be done in the way of improving the wild razor-back type, of which America and Canada apparently had an unlimited supply. As far back as 1816 there is a record of this attempt to improve the old Byfield and Russian hogs by crossing them with an imported type then known as the "Big China," a breed specially introduced for the purpose by one John Wallace, a leader of a sect of people known as "The Shakers." These "Big China" pigs were white in colour and were noted for the fine quality of their flesh and for their comparatively quick growth.

Later in the year 1834 an Irish type of pig—known as the "Irish Grazier"—resembling the old English Berkshire, was introduced into Ohio State, and the progeny of these pigs when mated with the native hog were so favourably commented on that the Berkshire type, as it was then, was, as opportunity offered,

PLATE 41.—A SOW OF THE VERY OLD TYPE OF POLAND-CHINA STILL SEEN IN PARTS OF QUEENSLAND, AND UNTIL RECENTLY EXHIBITED AT SEVERAL OF THE LEADING SHOWS.

freely introduced and used liberally for crossing on the partly improved stock available.

During the period 1816 to 1845 several other breeds and types of hogs were brought into south-western Ohio and were used in the building up of the breed, including the Irish Grazier, a medium-sized white hog with ears erect and with characteristics of smoothness and early maturity, and the Siamese, a small black hog of very early maturity. The Berkshires, introduced about 1839, were very large hogs "of even top and bottom lines, with good feet, not much depth of body, and drooping ears." These hogs were red and known in Ohio as Berkshires because their ancestors came from that part of England.

Other so-called breeds mentioned as having been used to a greater or lesser extent in the making up of Poland-Chinas were the Bedfords, or Woburns, the Byfields, Neapolitans, Russians, and others. These were not well-defined breeds such as exist to-day, but were terms used to designate certain kinds of animals with more or less variation in type.

It is claimed by the Poland-China Breed Promotion Committee of U.S.A. that the world's first real "corn belt" of commercial importance was in that region of south-western Ohio known as the Miami Valley, in which one of the principal problems presented to the farmers of that section was the production of a hog that

would best convert the abundant corn crops into pork and carry it to market. It is not likely that the men who assisted in the development of this breed had in mind a definite type of animal as the final result of their breeding operations; it was the corn belt and the corn-belt environments that determined the ultimate type. No one type or breed used in the moulding of Poland-Chinas exerted a predominating influence, but about 1850, when the process was considered complete, the result was a hog such as had never existed in the corn belt before. This hog was the product of the corn belt and of the constructive efforts and commanding genius of the farmers of that section. The claim has been made by those familiar with what took place that no new blood (*i.e.*, blood of other than the Poland-China breed) was introduced into the breed after 1845. By that time it had come to be well recognised as a breed, although it was known for some time by several different names, such as the Warren County hog, the Miami Valley hog, the Magie hog, and others.

The name ''Poland-China'' was officially adopted in 1872 at a convention of hog men held in Indianaopolis for the purpose of naming the breed. The word ''Poland'' is generally thought to be a misnomer. Some of the hogs that were used in the making up of the breed were known as Poland hogs. This led to the belief that they were descended from hogs imported from Poland. The facts of the case, as stated by the Poland-China Breed Promotion Committee, are that one of the most successful and outstanding hogmen of the period around the year 1840 was Ascher Ascher, a Polander by birth, who lived in Butler county, Ohio. He brought no hogs to that locality but was able to produce a superior class of hog from the material at hand, and sold a great many boars. His pigs were known as Poland hogs, and this formed a part of the breed's present name. Until 1870 the breed was largely described as dark spotted. Soon after, the fashion or fancy changed, and in a few years the breed was to a very large extent black with white points, and this is the prevailing preference to this time. No hard and fast rule is enforced as to the white points, and few breeders will discard a good animal because it has a little extra white on it. The first Poland-China record was established in 1877. Within three years two others were started and later the breed had six records. These have been reduced to three at the present time. Joint action of these three records for united breed promotion started in 1920, and is the most hopeful promise of the breeds future welfare. In Australia, Poland-Chinas are catered for, in so far as Herd Book registration is concerned, by the Berkshire and Yorkshire Society of Australasia, in whose Herd Books quite a large number of Polands have been registered. This society, which is controlled by a Federal General Council, has branch committees in each of the several States of the Commonwealth, so that Poland-China breeders desirous of registering their stock should get in touch with the local secretary in order to obtain full details.

In America an attempt was made some years ago (and with considerable success) by a number of breeders to retain the qualities of the original type under the name of the Spotted Poland-China, and since then this type has been developed to such an extent as to be quite distinct from the Poland-China proper; but these Spotted Polands have never attained the same popularity, nor have they been distributed to the same extent as the Poland-China proper. Even of the last-mentioned type, in America, there is two separate classes—one, the big-boned, growthy, lard type; the other the medium bacon or pork type, similar in colour and shape but distinct in size and development of bone. The types common in Australia are of this latter medium bacon and pork class, the former type has not yet been introduced.

As we have them now it is proved that success can be attained only by allowing them to have considerable range and by forcing them to take exercise freely every day. They should be given a variety of foods, not too liberal in quantity but of good quality. They have comparatively small appetites and have wonderful powers of assimilation, but unless they are judiciously handled and compelled to take exercise freely in these warm climates, they become sluggish and excessively fat. They must be allowed ample shade and fresh cold water, as they cannot stand continuous dry heat. They likewise require protection from the cold winds of winter and should be given adequate accommodation at all times.

Special care should be exercised to have the animals in proper condition at mating and at farrowing time—they must be in medium condition only, not too fat nor too thin and worn. They must at all times be carefully bred and fed, and it is wise to introduce fresh blood occasionally, as the type is inclined to deteriorate unless properly attended to. Special care should likewise be paid to the selection of breeding stock from large, thrifty, sturdy litters correctly marked and shaped and of proved vigour.

Poland-Chinas were first introduced into Australia about forty years ago by one William Marks, but records showing from where the type came appear to have been

PLATE 42.—POLAND-CHINA SOW, "SYLVIA."

PLATE 43.—POLAND-CHINA BOAR, "PENATES."
Age, 7 months. Weight, 181 lb.

These two photographs represent the type of Poland-China common in New South Wales 30 years ago.

lost. One of the early breeders, and who still handles this breed, is Mr. G. H. Gray, of Federal, Richmond River, N.S.W. Writing concerning his experiences, Mr. Gray says:—"I have been a breeder of pure-bred Poland-China pigs since 1882, and have never in-bred my stock. Have never had a Poland condemned on slaughter, and have sent pigs of this breed to the bacon factory for over twenty-five years. Am still breeding and selling boars and sows and sending them all over the State. I bought my first Polands from T. H. Davey. He got his pigs from A. M. Woodhouse out of imported American stock about 1882, and in 1885 I bought a young boar from A. A. Dunnicliffe, of Burrawong, New South Wales. The sire of this pig was 'Crown Prince Imported,' his dam being called 'American Imported.' The records of his breeding also appear to have been lost, although it is understood that he was of the 'Magie' strain bred by D. M. Magie, of Butler County, Ohio, for in those days pedigrees were not as carefully preserved and recorded as they are now nor were there any record associations for pigs in Australia."

Probably the earliest importations of value in improving the type of Poland-China in Australia were those made by the New South Wales Government about twenty-five years ago. These, at any rate, were the first to be recorded, and prominent amongst these was the boar named after that famous American Statesman and President, Abraham Lincoln. Another boar imported at the same time was called "Roosevelt." He also came from the Flossmoor Stock Farms, Illinois, and although not as true to type as "Lincoln," he left a lot of very useful stock in the studs in which he was used, principally at the Hawkesbury College.

Many years before this there was a boar imported whose name was "United States." He also appears to have come from the Flossmoor Farms, but his pedigree also has been lost. The boar "Abraham Lincoln" was the best Poland ever introduced into Australia prior to 1912. It was in that year that the New South Wales Government made a further importation for the Hawkesbury Agricultural College stud; these were high-class pigs, and it was the progeny of these importations that are recorded as the parents of most of the Polands we have to-day. Prominent amongst the animals forming this shipment was the boar called "Manager," 177881, bred by Jno. Francis and Sons, of Illinois. Amongst the sows in this same shipment was one called "Chicago's Pride," another sow was named "Iowa Beauty," still another was known as "Missouri Girl," whilst the other two were named "Winconsin Pet" and "Kansas Pearl." Two sows, which formed part of the shipment of which the boar "Manager" formed a part, were named "Ohio Beauty" and "Ohio Gem," but neither of these sows were successful breeders, therefore none of their stock have been recorded.

Probably the most useful boar we have ever had, so far as a sire, was the boar "Sydney," 228381, bred by J. G. Drennan, of Chicago. This boar was imported in 1913, and was an active, serviceable animal until quite recently. He has sired more Poland-Chinas than any boar it has been Australia's good fortune to import, and was the best and truest specimen of this now famous type. A fellow voyager from the U.S.A. in 1913 was a boar named "Judge K," bred by J. S. Kemp, of West Kenney, Illinois. He was sired by a boar called "On the Dot," 106355, and was from a sow, "She's a Honey," 403940. He represented a less prepotent type, probably more suited to the State's trade than to the markets of the South of Queensland. "Judge K" was, however, a good investment, as he left a host of useful pigs behind him, and it is the progeny of these two boars mated with representatives of the earlier importations that have been distributed throughout Australia.

More recently still Messrs. Wilson and Keppie, of "Woodlands," Paterson, New South Wales, have come to the rescue of Poland-China breeders and have imported several first-class animals from Canada. These have developed into very fine specimens of the breed, and their progeny are now being distributed; they are distinctly unrelated to the types formerly imported and are therefore filling a very useful purpose in the breed.

The great call in Queensland is for a medium type pig that will grow into a prime bacon pig, dressing from 110 lb. to 130 lb. at six months of age. These same pigs would weigh round about 300 lb. live weight at twelve months old if they were forced on to those weights, but we find it unprofitable to exceed the 130 lb. dressed limit, and the tendency is now to reduce this weight to 120 lb. dressed, as representing the most profitable sale weight.

For the production of medium-weight porkers, weighing about 70 lb. dressed at four and a-half months old, the Poland-China is an ideal type, but there is not a great demand for pork in Queensland, hence we find the Poland-China more useful for crossing with the Berkshire grade or even with Tamworth grade pigs. A Poland-China boar mated with these types gives excellent results. Poland-Chinas are destined to become one of the most profitable of all breeds, provided they maintain a fair standard of proficincy and do not become too coarse or heavy. As a

breed they are not noted for great prolificacy, and an average litter of eight must be considered good, but they have acclimatised well and appear to be more prolific under Australian conditions than they are in their native home. However, they possess a wonderful aptitude to fatten readily on a comparatively small amount of food, whilst they are easy feeders and contented; these are features that must to an extent stand them in good stead even if they are less prolific than some of the other breeds.

In summing up their good qualities, one of the American Poland-China Records says:—

(1) They are the best known machines for manufacturing corn into pork. They thrive better than any other breed upon a diet composed mostly of corn.

(2) They are docile, hardy, reasonably prolific, and almost invariably good mothers.

(3) In large pastures they are not inclined to waste flesh by over-exercise; they have little or no desire to roam far away from home.

(4) The better type Poland-China has as small a proportion of "offal," in comparison with the size of their carcass, as any hog in the hands of the general farmer. Their great feature is their easy and quick-fattening propensities with a tendency to very early maturity.

The recent importations of Poland-Chinas have done much to popularise and improve the type, but we want more of them as they are bound to prove of great value here in introducing their several valuable qualities into our herd. Poland-Chinas are the ideal type for the suburban pig farmer, as they cross well on comparatively common stock; stock that are usually deficient in compactness, early maturity, and food feeding qualities.

Special attention should be paid in selecting pigs of this breed to ensure purity of type. This is more important than with some of the other older established breeds; select long roomy sows that give every evidence of constitutional vigour. Avoid delicate sows, short in body and showing excessive fat, and with drooping quarters and coarse curly hair.

Scale of Points adopted by the several Record Associations in America for the Poland-China breed:—

Colour.—Black, with white points, tip of tail, four white feet, white in face, or on nose, or on point of lower jaw, all to be perceptible without close examination; splashes of white on jaw, legs, flank, or few spots on body not objectionable.

Skin.—Fine and free from wrinkles.

Hair.—Fine, straight, smooth, lying close to and evenly distributed, covering the body well.

Head and Face.—Broad, even and smooth, wide between and above the eyes, slightly dished, tapering evenly and gradually to near the end of nose, broad lower jaw, head moderately short.

Ears.—Neither too large nor too small, but even, fine, thin, leaf shape, slightly inclined forward, standing up slightly at the base to within two-thirds of the tip, where a gentle droop should occur.

Jowl.—Broad, deep, smooth, and firm, carrying fulness back near to point of shoulders, and below the lower jaw, so that lower line will be as low as breast bone when head is carried up level.

Neck.—Wide, deep, short, arched on top from poll to shoulders.

Shoulders.—Broad and oval on top, showing evenness with back and neck, with good width top and bottom, and even smoothness extending well forward.

Back and Loin.—Broad, straight or slightly arched, carrying same width from shoulder to ham, ribs well sprung.

Flank.—Belly broad, straight and full, flank well let down, with straight underline.

Hams.—Broad, full, deep, and long from rump to hock, fleshy, plump, and rounding fulness perceptible everywhere.

Legs and Feet.—Legs medium length, straight heavy bone, well set apart, and squarely under body, wide above knee and hock. *Feet.*—Firm, short, and strong.

Action.—Free, clean, firm, easy, and graceful.

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON, F.R.A.S.

TIMES OF SUNRISE AND SUNSET.

AT WARWICK.

1924.	JANUARY.		FEBRUARY.		MARCH.	
Date.	Rises.	Sets.	Rises.	Sets.	Rises.	Sets.
1	5·1	6·49	5·25	6·46	5·46	6·23
2	5·2	6·50	5·26	6·46	5·47	6·22
3	5·3	6·50	5·27	6·45	5·47	6·21
4	5·3	6·50	5·28	6·44	5·48	6·20
5	5·4	6·50	5·29	6·43	5·48	6·19
6	5·5	6·51	5·30	6·43	5·49	6·17
7	5·5	6·51	5·30	6·42	5·49	6·16
8	5·6	6·51	5·31	6·41	5·50	6·15
9	5·6	6·51	5·32	6·40	5·50	6·14
10	5·7	6·51	5·33	6·39	5·51	6·13
11	5·8	6·51	5·33	6·39	5·51	6·12
12	5·9	6·51	5·34	6·38	5·52	6·11
13	5·10	6·51	5·35	6·38	5·53	6·10
14	5·11	6·51	5·36	6·37	5·54	6·9
15	5·12	6·51	5·36	6·36	5·54	6·7
16	5·12	6·51	5·37	6·35	5·55	6·6
17	5·13	6·51	5·38	6·35	5·56	6·5
18	5·14	6·50	5·38	6·34	5·56	6·4
19	5·15	6·50	5·39	6·33	5·57	6·3
20	5·16	6·50	5·40	6·32	5·57	6·2
21	5·16	6·50	5·40	6·32	5·58	6·0
22	5·17	6·50	5·41	6·31	5·58	5·59
23	5·18	6·49	5·41	6·30	5·59	5·58
24	5·19	6·49	5·42	6·29	5·59	5·57
25	5·20	6·49	5·42	6·28	6·0	5·56
26	5·20	6·48	5·43	6·27	6·0	5·55
27	5·21	6·48	5·44	6·26	6·1	5·53
28	5·22	6·47	5·45	6·25	6·1	5·52
29	5·23	6·47	5·45	6·24	6·2	5·51
30	5·24	6·46	...	...	6·2	5·50
31	5·25	6·46	...	...	6·3	5·49

PHASES OF THE MOON, OCCULTATIONS, &c.

The times stated are for Queensland, New South Wales, Victoria, and Tasmania, when "Summer" Time is not used.

6 Jan.	●	New Moon	10 48 p.m.
14 ,,	☾	First Quarter	8 45 a.m.
22 ,,	○	Full Moon	10 57 a.m.
29 ,,	☽	Last Quarter	3 53 p.m.

Perigee 4th Jan., at 8·12 p.m.
Apogee 16th Jan., at 2·42 p.m.

On 1st January, at midday, the earth was 3,000,000 miles nearer to the sun than it will be on 3rd July at 11 p.m. Mercury will be at inferior conjunction with the sun on the 13th at 2 p.m. The moon will pass above the planet Neptune on the 24th at 7 p.m., at an apparent distance of about three times its diameter.

5 Feb.	●	New Moon	11 38 a.m.
13 ,,	☾	First Quarter	6 9 a.m.
21 ,,	○	Full Moon	2 7 a.m.
27 ,,	☽	Last Quarter	11 15 p.m.

Apogee 13th Feb., at 11·42 p.m.
Perigee 26th Feb., at 1·54 a.m.

The planets Venus and Uranus will be apparently remarkably close to one another on 1st February, Venus being the uppermost. On the 5th Mercury will be at its greatest elongation west of the sun at a distance of 25½ degrees. Neptune will be at its highest position about midnight on the 9th. Mars and Jupiter will seem to be remarkably close to one another on the 14th at about 3 a.m. There will be a total eclipse of the moon in the early hours of 21st February, when the moon will enter the earth's umbra or darker shadow a little after midnight. It will be totally eclipsed between about 1·20 a.m. and 2·57 a.m., and will leave the umbra about 4 a.m.

6 Mar.	●	New Moon	1 59 a.m.
14 ,,	☾	First Quarter	2 50 a.m.
21 ,,	○	Full Moon	2 30 p.m.
28 ,,	☽	Last Quarter	6 24 a.m.

Apogee 12th March at 7·54 a.m.
Perigee 24th March at 3·12 a.m.

On 5th March a partial eclipse of the sun will be visible in parts of South America and South Africa, but not in Australia. The planet Uranus will be in conjunction with the sun, which will pass between the earth and Uranus, on the 8th at 6 p.m. Jupiter will be at quadrature with the sun on the 9th at midnight. Being west of the sun, it will be visible from about midnight to dawn.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S., add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhere about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

CANE PEST COMBAT AND CONTROL.

The Entomologist of the Bureau of Sugar Experiment Stations at Meringa, near Cairns (Mr. E. Jarvis), reports to the Director (Mr. H. T. Easterby) under date 7th February, 1924:—

Weight of Male and Female Greybacks.

In order to determine differences in weight between the sexes of *albohirtum* during development of the ovaries, numbers of these beetles were collected at random from feeding-trees near the Laboratory and carefully weighed. Ten days after emergence (21st December) it required 264 living females or 280 males to weigh 1 lb. av. Thus, during this interval, each female had become nearly half a drachm heavier, or equivalent collectively to the total weight of eighty beetles. It appears, therefore, that a single female prior to full development of the ovaries weighs about 26 grains av., but when containing eggs of a size fit for exclusion weighs at least 38 grains = 2 scruples. Later on in the flighting season, when about 50 per cent. of females had oviposited, those containing fully-grown eggs could at once be separated from the above by this decided difference in weight.

As already pointed out in a previous report (February, 1922), the grey-back cane beetle, although of bulky proportion, is well adapted for migration, being relatively lighter in weight than many smaller and closely related scarabæidæ; while its buoyancy, large size, and big expanse of wing prove decided aids to such aerial transportation.

Distribution of Tachinid Parasites.

Since reporting last October, nineteen additional canegrowers have been supplied with consignments of tachinid flies, sixteen of these being residents of the South Johnstone area, and the remainder of Goondi, Highleigh, and Mount Sophia.

The abovementioned liberations have taken the form of seventeen specially constructed breeding boxes containing in all 128 fly-infested cane sticks taken from our large rearing cages, each stick harbouring from ten to twenty or more pupæ of this tachinid.

As a result of such liberation fully 1,600 flies are expected to issue from these boxes, which, as previously reported, are established in the canefields among stools affected by grubs of the beetle-borer. After escaping through slits left in the cover for this purpose the tachinids fly off the boxes, and finding themselves in the immediate vicinity of their host are able to at once commence the useful work of parasitising the borer grubs. It is encouraging to be able to state that whilst "scouting" for flies at the farm of Mr. B. Salleris at No. 1 Branch, parish of Johnstone, on 18th January, Mr. G. Bates was successful in finding three empty puparia of *Ceromasia sphenophori* in a standing cane-stick, indicating that the parasite has been able to gain a footing and commenced to breed naturally in that locality. Forty flies were liberated at this spot on 1st November, and a box containing seven fly-infested sticks was also established there on 14th December.

Experiments with Para-dichlor.

A number of plots situated in various localities have been injected with paradichlor. in order to observe its effect on cane-grubs when applied in small doses.

Some of these plots were treated a week or so after emergence of the beetles, to see whether egg-laden females would oviposit in soil contaminated with the odour of this compound.

It is hoped to establish additional plots during the month of February until commencement of the wet season.

Experimentation in this connection has been entrusted to Assistant H. Knust, who obtained considerable experience in this class of field work last season. Half a ton of para-dichlor. has been received this month (January) at Meringa Experiment Station, the sample being of good quality and costing about £2 5s. per cwt.

At this price it would cost about £1 18s. to treat an acre consisting of 6,000 stools with ½ oz. doses injected on each side of the rows of cane.

Poisoning Greyback Cane-beetles.

Experiments have been conducted this season to test the insecticidal value of arsenical dust sprays, which in field practice are more easily and conveniently applied in this form than when mixed with water. Results obtained by the writer during past years have shown that both lead and copper arsenates in solution will kill beetles of *albohirtum* in from eight to ten days after feeding.

Data derived this season from the application of dry arsenicals indicate that these poisons, when dusted thinly on the leaves of favourite food-plants, will kill the beetles in less than two and a-half days after feeding.

The investigation in question took the form of ten separate experiments in which 299 beetles were used, including 104 control specimens. Ten per cent. of the beetles eating leaves poisoned with lead arsenate died half a day after feeding, while 50 per cent. of those eating Paris green succumbed one day after feeding.

N.U.P.B.A. COMPETITION, ZILLMERE.

There were 2,269 eggs laid in January, an average of 17¼ eggs per bird. One death occurred, Mr. S. Lloyd's No. 63, from bowel trouble. Birds reported broody during the month:—8, 19, 25, 46, 50, 84, 92, 97, 98, 103, 104, 110, 112, 113, 115, 120, 128, 131.

WHITE LEGHORNS.

Pen No.	Owner.	Jan.	Total.
62	Miss L. M. Dingle	25	u258
14	Enroh Pens	24	u249
72	W. H. Forsyth	19	227
75	W. Shaffrey	20	u227
4	T. H. Craig	25	226
27	H. T. Britten	21	u225
28	H. T. Britten	25	224
50	J. Harrington	16	224
15	W. J. Berry	20	u223
51	Kidd Bros.	24	222
66	R. Duff	21	222
7	Oakleigh P.F.	27	221
13	Enroh Pens	20	220
20	W. Witt	24	220
22	M. F. Newberry	23	218
16	W. J. Berry	22	u217
41	W. Wakefield	23	217
59	G. A. Scaletti	25	217
33	A. S. Walters	22	216
43	Kelvin P.F.	21	215
53	H. Holmes	26	u215
30	W. and G. W. Hindes	22	212
49	J. Harrington	21	212
73	A. Hodge	23	212
71	W. H. Forsyth	24	211
8	Oakleigh P.F.	14	210
10	R. C. J. Turner	25	u207
18	A. W. Ward	14	205
78	W. Smith	24	205
58	H. Fraser	29	u204
69	R. Shaw	21	204
84	L. Andersen	12	204
2	Carinya P.F.	24	203
54	H. Holmes	23	u203
3	T. H. Craig	24	201
42	W. Wakefield	19	201
74	A. Hodge	21	201
37	G. Williams	22	200
38	G. Williams	20	198
61	Miss L. M. Dingle	15	198
70	R. Shaw	21	198
21	M. F. Newberry	26	194
26	E. Stephenson	19	193
48	R. D. Chapman	15	192

Pen No.	Owner.	Jan.	Total.
55	G. A. Baxter	18	192
83	L. Andersen	24	192
36	J. T. Webster	20	191
40	J. Earl	22	191
34	A. S. Walters	21	u190
64	S. Lloyd	8	190
45	F. R. Koch	17	187
76	W. Shaffrey	17	187
23	Parisian P.Y.	20	186
77	W. Smith	20	186
29	W. and G. W. Hindes	9	184
44	Kelvin P.F.	20	184
81	J. E. G. Purnell	6	184
11	A. Neil	19	182
12	A. Neil	18	u181
1	Carinya P.F.	13	180
52	Kidd Bros.	23	179
47	R. D. Chapman	23	178
6	P. Fallon	18	176
63	S. Lloyd	8	u176
32	H. Needs	23	176
39	J. Earl	22	174
5	P. Fallon	21	173
35	J. T. Webster	13	167
57	H. Fraser	14	166
25	E. Stephenson	14	u160
56	G. A. Baxter	14	160
24	Parisian P.Y.	16	159
31	H. Needs	14	159
79	W. Bliss	22	159
19	W. Witt	9	155
17	A. W. Ward	12	154
85	A. Cowley	6	153
46	F. R. Koch	14	150
9	R. C. J. Turner	25	u146
82	J. E. G. Purnell	15	140
67	J. and G. Green	9	137
68	J. and G. Green	0	115
60	G. A. Scaletti	11	97
65	R. Duff (replaced 6th October, 1923)	23	84
80	W. Bliss	7	64
86	A. Cowley	5	38

BLACK ORPINGTONS.

Pen No.	Owner.	Jan.	Total.
92	J. Pryde	14	u235
95	J. Potter	13	233
101	Enroh Pens	21	228
109	T. H. Brotherton	19	223
117	E. C. Raymond	23	220
89	K. Macfarlane	15	207
115	C. C. Dennis	16	u202
110	T. H. Brotherton	19	200
96	J. Potter	24	199
93	H. B. Stephens	29	u197
113	E. Walters	15	197

Pen No.	Owner.	Jan.	Total.
118	E. C. Raymond	23	197
105	W. Smith	16	187
112	H. M. Chaille	2	187
90	K. Macfarlane	19	185
87	Parisian P.Y.	15	179
91	J. Pryde	21	u179
111	H. M. Chaille	17	179
120	J. Harrington	12	179
106	W. Smith	22	177
88	Parisian P.Y.	14	172
108	E. F. Dennis	15	171

"u" indicates eggs underweight.

N.U.P.B.A. COMPETITION, ZILLMERE—*continued.*

BLACK ORPINGTONS—*continued.*

Pen No.	Owner.	Jan.	Total.	Pen No.	Owner.	Jan.	Total.
116	C. C. Dennis	12	166	103	L. Pritchard	12	134
102	Enroh Pens	11	163	114	E. Walters	0	u125
104	L. Pritchard	9	163	97	W. Shaffrey	7	123
98	W. Shaffrey	13	161	107	W. Shaffrey	7	123
99	S. Donovan	19	149	127	E. F. Dennis	0	108
94	H. B. Stephens ..	14	148	100	S. Donovan	8	90
119	J. Harrington ..	0	146				

OTHER VARIETIES.

Pen No.	Owner.	Jan.	Total.	Pen No.	Owner.	Jan.	Total.
131	W. H. Forsyth (S.W.)	10	219	123	J. Ferguson (Anc.) ..	10	143
125	J. Ferguson (Lang.) ..	13	201	130	R. A. Girling (Min.) ..	21	138
126	J. Ferguson (Lang.) ..	12	170	129	R. A. Girling (Min.) ..	21	129
128	A. S. Walters (B.R.) ..	9	154	132	W. H. Forsyth (S.W.)	19	u129
127	A. S. Walters (B.R.) ..	20	147	124	J. Ferguson (Anc.) ..	9	124
122	Parisian P.Y. (B.L.) ..	21	145	121	Parisian P.Y. (B.L.) ..	11	u111

"u" indicates eggs underweight.

The Cultivation and Curing of Tobacco.

PIPE and CIGAR.

Profitable Tobacco-growing.

To the question, "Is the growing of heavy export tobaccos profitable, or can Queensland growers compete with other countries in other markets?" the answer is,—Yes, if the farmers are willing to adopt modern methods, and conduct their farming operations upon lines followed by other agricultural communities. Not only that, but they can practically monopolise the market for this class of tobacco in these States, as it is conceded that, so far, this State gives promise of being able to produce the best tobacco grown in Australia. Given the soil and a sufficient rainfall, the cost of production in this State should be less than it is in the United States, for the following reasons:—The Queensland farmer does not require to feed his working stock through a long hard winter, his taxes are little more than half those imposed on the farmer in the United States, and he gets a larger yield than the latter, and I might also add the prices realised here are better than anywhere in the world for the same type of tobacco.

Ordinarily, the amount of tobacco produced here is not commensurate with the labour performed, and for the reason that the labour is often not properly directed.

It is doubtful if any one crop, to the exclusion of all others, can be made profitable one year with another, employing only one-third or one-half of a man's time, and the balance idle or doing wage work when he can get it. By diversifying the crops of the farm, and making tobacco

one of the crops, the farmer does not then depend upon one crop for the whole of his income and sustenance, and he is sure to get a good price for one or more of his products, besides producing his own food, which he can do cheaper than he can buy it out of his tobacco money.

Our manufacturers have shown both liberality and enterprise in their efforts to foster this industry; and it is now up to the farmers to meet this with an effort to produce exactly what the trade demands. There is plenty of suitable land for the production of high-class Pipe Tobacco leaf in the Inglewood and Texas districts, to be had at a moderate price.

Methods.

It goes without saying that the one-crop system requires a higher average of prices to be more profitable than that of several crops.

The cost of production in Queensland can be materially lessened by substituting the plough for the hoe, as I have heretofore suggested —a process which will increase the quantity and improve the quality. Improved curing-sheds and improved methods of curing will also give additional weight to the tobacco, besides improving its quality. The labour of transplanting can be much lessened by a thorough preparation of the ground beforehand, by deep ploughing and deeper cross-ploughing, and thorough harrowing, and getting the soil into the best of tilth. By this means a proper arrangement of soil particles is obtained, and the land is in the best physical condition, influencing beneficially both the temperature and the moisture; the free access of air is secured, supplying the necessary amount of oxygen, and the soil is in such a condition of fineness as to allow a perfect root development.

These are all essential to healthy plant life; and when these conditions exist, the farmer will have fewer plants dying from transplanting, and the labour will be materially lessened. It should be evident to everyone that the soil, in such condition as to supply, fully, all that plant life demands of it, will give the best results in every particular, and this condition cannot be obtained without the free use of the plough.

Comparative Analyses of Tobacco.

The subjoined analyses of Dark Virginia and Queensland Texas raw leaf were made by Mr. J. C. Brünnich, chemist to the Department of Agriculture.

The Queensland tobacco, it will be seen, compares very favourably with the American, and I do not think, to judge by the analyses, that the production of excellent Queensland tobacco presents any difficulties that cannot be overcome. It should be borne in mind that different localities often show a modification of the same product, and the comparatively lower nicotine content, as here shown, does not materially affect the position of the Queensland-grown leaf.

	unty,	Valleyland Subsoil, Henderson County, Kentucky.		QUEENSLAND TOBACCO SOIL. From Texas District.	
OPERTIES OF THE					
Reaction ..		Neutral.	..	Neutral.	..
Weight of soil per		774	..	806	..
Capacity for water		54·0	..	56·4	..
Absorbed weight pe		418	...	454	..
Capillary power, a hours		8¾, 11¼, 15, 18¼, 21¼ in.	..	6½, 10, 12½, 15½, 17¾ in.	..
Absorptive powers		64 c.c.	..	66 c.c.	..
	triat.	Ordinary Elutriat.	Schöne's Elutriat.	Ordinary Elutriat.	Schöne's Elutriat.
CHANICAL ANALYS					
tones over 5 mm.	11·81	..	10·25	..	29·28
Gravel over 2 mm.	17·77	Nil.	21·88	Nil.	7·58
and (fine) ..	36·99	34·57	33·15	37·25	19·58
ine sand (very fin	7·97	38·19	9·91	30·54	12·23
lay	18·09	19·34	16·91	24·97	24·09
rganic matter and	7·37	7·90	7·90	7·24	7·24
egetable fibres an		Nil.	..	Traces	..
	ses.	Agric. Analyses.	Absol. Analyses.	Agric. Analyses.	Absol. Analyses
MICAL ANALYSES					
Moisture ..		2·092	7·094	2·288	7·244
Humus (humic acid		3·490		3·346	
Other organic matt		2·322		1·610	
hlorine ..	7	·006	·006	·009	·009
arbonic acid ..	5	·220	·220	·120	·120
otal nitrogen ..		·110	..	·179	..
oluble in HCl of 1					
Sol. silica ..	7	·009	74·308	·182	71·191
Sulphuric acid	1	·025	·025	·117	·117
Phosphoric acid	5	·110	·114	·139	·146
Iron	5	2·719	13·066	2·723	4·048
Alumina ..		2·821		5·168	12·866
Lime	2	·315	1·320	·515	1·646
Magnesia ..	3	·413	·886	·502	·840
Potash ..	1	·190	1·280	·489	1·275
Soda	2	·180	·871	·162	·498
nsoluble in HCl of		*85·130	..	*83·374	..
Tot	0	100·042	100·000	100·744	100·000

* Ir clay = 13·04 .. clay = 16·78

REMARKS :—S f 1·1 sp. gr., but also absolute analyses, by making the whole soils soluble
n the aid of hydro these very finely textured soils were also made by two different methods,
clay found by bot

The analyses s little more of the coarsest sand, and also a little more clay ; it is also not
e so porous, with

The absorptive coefficient from 200 to 300 ; it means that if the soils are heavily manured
ss of manure may

COMPARATIVE ANALYSES OF TOBACCOS.

	Dark Virginia Raw Leaf. Per Cent.	Queensland Texas Raw Leaf. Per Cent.
Moisture	9·44	10·48
Nicotin	4·52	2·54
Ammonia	·53	·07
Nitric acid	·83	1·05
Malic acid	12·05	10·72
Citric acid	2·81	4·55
Oxalic acid	3·18	3·64
Acetic acid	·55	·79
Tannic acid	1·80	1·50
Pectic acid	7·18	9·55
Pectose bodies and gums	3·61	4·55
Albuminoids	11·92	12·20
Other insolvent organic matters (diff.)	6·87	10·35
Cellulose	10·22	7·95
Oils, fats, chlorophyll	5·90	4·16
Resins	4·51	2·87
Starch	·64	·58
Total pure ash	13·64	12·45
Ash containing—		
Silica and sand	3·78	1·60
Phosphoric acid	·38	·56
Sulphuric acid	·56	·47
Chlorine	·74	·52
Lime	3·94	3·59
Magnesia	1·04	·91
Iron and alumina	·46	·44
Potash	2·60	3·79
Soda	·13	·57
The tobaccos contained—		
Total nitrogen	2·753	2·410
Amido nitrogen	·616	·812

Analyses of Tobacco Soils.

American and Queensland Soils Compared.

In order to give those who may contemplate tobacco-growing an idea of the character of the soil likely to produce the best quality of tobacco, I herewith submit an analysis made by Mr. Brünnich, together with his footnote, of some of the best American tobacco soils and of the soil of Texas (Queensland). It will be borne in mind that these soils grow only the heavy or export types of tobacco. This analysis shows a great similarity in all of these soils, and, I may state, corresponds very closely to the analysis made by the United States Department of Agriculture as to their physical properties.

These soils are all in limestone country, which is nearly always the case where our best heavy tobaccos grow. It may be well to state that very heavy soils, producing rank growth, never produce good tobacco. All tobacco land should be well drained. It may be well for

the further information of intending growers to quote from the United States Bulletin No. 11, Division of Soils, that they may understand that all does not depend upon soil:—

Experience the only Safe Test of Climate for Tobacco.

One must still judge, so far as the climate is concerned, mainly from the experience of others as to the class of tobacco to be raised, as the ordinary meteorological record will be of very little value in determining this point. The plant is far more sensitive to these meteorological conditions than are our instruments. Even in such a famous tobacco region as Cuba, tobacco of good quality cannot be grown in the immediate vicinity of the ocean or in certain parts of the island, even on what would otherwise be considered good tobacco lands. This has been the experience also in Sumatra and in our own country, but the influences are too subtle to be detected by our meteorological instruments.

Little, therefore, can be said at the present time in regard to the suitable climatic condition for tobacco of any particular type or quality. But a humid climate is necessary during growing season.

Soils of the Tobacco Districts.

Under given climatic conditions the class and type of tobacco depend upon the character of the soil, especially on the physical character of the soil upon which it is grown, while the grade is dependent largely upon the cultivation and curing of the crop.

Making Seed Beds.

Seed beds should be sown, and the plants transplanted to the field, just as is done with cabbage. After clearing the soil of any timber growth and before stirring the soil, wood, bark, and leaves should be placed on the land and set fire to. The ground should be burned sufficiently to destroy all weed seeds, grass roots, &c. The reasons for this are several. It destroys weeds and grass, and no weeding of the beds will be necessary, and this saves much time and labour; the ashes serve as a good fertiliser, and the small bits of charcoal greatly conserve the warmth of the bed. After the ground has cooled, rake off any *débris* that may be left unburnt, but leave the ashes on. Dig the bed well to the depth of 6 or 7 inches, taking care to reverse the soil; work and rake it until you have made it as fine as possible.

Virgin soil is the best for seed beds, and should not be on low-lying, wet, or foggy flats; the land should be convenient to water, that the plants may be watered when needed. If the beds are made on low, damp, or foggy flats they will be more liable to disease.

Sowing Seed Beds.

The quantity of seed to be sown is about a teaspoonful to a bed 5 by 20 feet or 100 square feet. The day before sowing put the seeds into a glass of water, and let them stand for two or three hours. By that time, all the seeds of strong vitality will have settled to the bottom of the glass; those left floating on top are either sterile or of such low vitality as to produce only weakling plants. Pour off the water and take only the seeds left in the bottom of the glass. Dry them in the sun or near the fire; then mix them with ashes or lime thoroughly, and sow evenly over the bed. In drying seeds after taking from the water only a few minutes are necessary to get the dampness off them that they may not stick together when mixing with the ashes or lime. *After sowing the seed, do not rake or tramp it in, but take a sprinkler and sprinkle water well, carefully, and evenly over the bed, not allowing the water to run in little streams on the surface, as this disturbs the position of the seed and makes the plants thick and thin in the bed. As the water soaks in, go over the bed again and again, until it is well watered. This will give a sufficient covering of earth to the seed.*

Do not wait for rainy or seasonable weather for sowing your beds, but sow in time to have plants ready for transplanting when the seasonable weather begins.

This you can do by watering your beds regularly as described under the section "Treatment of Seed Beds."

Do not sow all your beds at one time, but sow one or two beds every week or ten days, so that you will have plants coming on at different times, which gives you more time for getting out your crop. Sow plenty of beds, so as to have plenty of plants. Be careful to sow evenly over the bed.

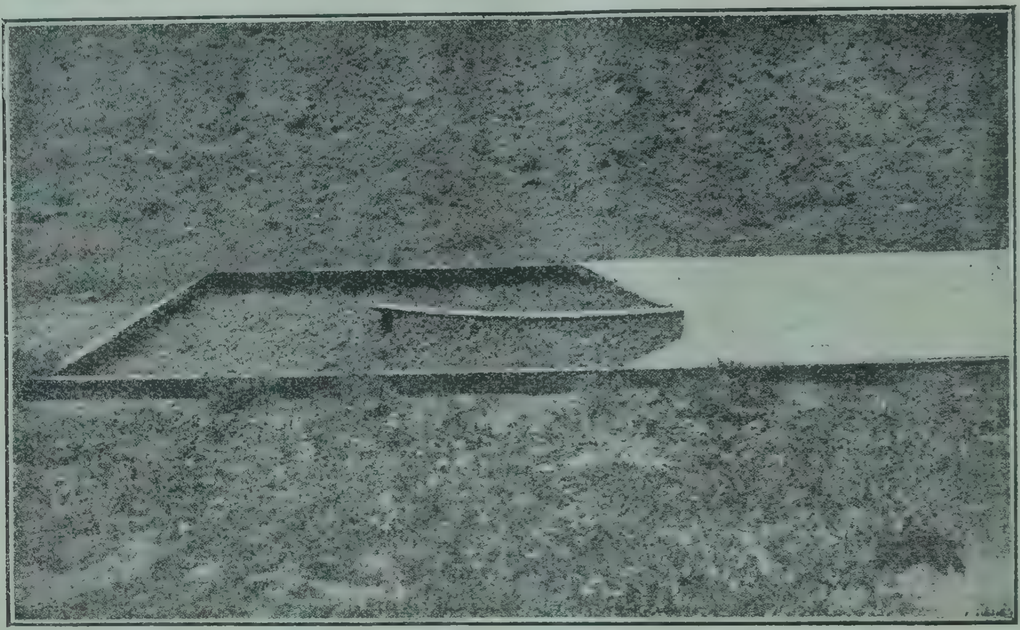
Treatment of Seed Beds.

After sowing, the beds should be covered. Butter cloth or calico is best; but, in the absence of these, grass can be used. *This covering is necessary, as the hot sun will kill the plants as they sprout, or "in the crook,"* as the Yankees say.

As the plants begin to grow, they should be gradually hardened by removing the covering each day for awhile, making the time longer each day until they are left entirely uncovered for a week before transplanting. *If the weather is dry, the beds should be watered at least every other day, late in the afternoon, until the plants come up, which may be a week or it may be two weeks, owing to the season.*

If the sun is very hot, a good covering of grass laid flat on the ground is the better plan until the plants are up; and, as they begin to grow, this covering should be thinned, but the grass covering need not be removed when the plants are watered.

After the plants are well up, water as they need it, but not too much or they will grow up thin and sappy, and will not stand transplanting so well. Before sowing the seed, it is a good plan to sow about ½ of an inch of sand over the bed. This prevents the ground cementing so badly when the plants are being watered. When they have developed four to six leaves, care should be taken not to water too much, or "blue mould" may develop on the plants. They should only have enough water to keep them healthy. A slow-growing plant in the bed, if healthy, is usually hardy. Thin out the plants if they are too thick in the bed; also pull up any weeds that may appear in the beds, but if the beds are well burned you will not be troubled with them.



SEED BED AND COVERING.

Insect Pests.

Stem Grubs in Tobacco.

Some experiments made in destroying the stem grub in the plant beds by Mr. Charles Toon, of Toon and Kiss, tobacco-growers on Eurie Creek, Bowen, will be of interest to tobacco-growers generally, and should further trials show it to be effective, it will certainly be a great saving to the growers throughout Australia. Mr. Toon says he was able to keep his seed beds entirely free of the stem grub by spraying with the arsenate of lead—two teaspoonfuls of the lead to 1 gallon of water. The first spraying was given when the plants showed three or four leaves; he sprayed again four days later, and there were no stem grubs in the beds so treated, while the beds not treated were badly infested, as were those of his neighbours. On examination of the treated plants he says he found dead grubs just entering the stem of the plant, and also dead ones that had effected an entrance, but in no instance did he find any alive, and

all had died before doing any injury to the plant. Mr. Toon is quite convinced the remedy is effective, and it is to be hoped other growers will find it so.

The following remedy (taken from "The Western Tobacco Journal") might be tried on beds to prevent the stem grub, as it is simple and cheap:—"A new and what is believed to be an effective preventive method to circumvent the ravages of the troublesome cut worm has been discovered by an Orfordville (Wis.) tobacco-grower, which is so inexpensive and simple that it ought to commend itself to very general use. Here it is: Add to each barrel of water used in the transplanting about 5 oz. of ordinary carbide, such as is used in the making of gas for lighting plants, autos, &c., making the water so offensive that it is alleged that worms will not go near the plants. The remedy works so well that the discovery has been given the State Experiment Station for further trial, and it is believed that bulletins will be issued commending it to general use. The grower who first made use of this mixture says it is a sure cure. At any event, it is worth a trial. If all that is claimed for it is true, the discovery may become a great help to the tobacco-growers of the entire country."

Diseases in Tobacco.

The only disease that is troublesome in Australia is Blue Mould, that mostly attacks the plants in the seed beds, though sometimes it manifests itself in the field. No sure remedy for it is known, but when it is present in the country as little watering of beds as is possible for the plants to live should be done. About ½ inch of pure sand, placed on top of the beds before sowing, will tend to conserve the warmth of the bed, thus minimising the danger of this disease, and also prevent the beds from caking when watering.

Improving the Tobacco Plant.

A series of interesting experiments has been carried out by Dr. Trobut, of Algeria, that prove tobacco may be improved by proper cultivation and selection, and are given in "The Western Tobacco Journal," and herewith reproduced. It is a most valuable contribution to the tobacco industry, and should be carefully read and studied by every grower in Queensland.

These experiments have been made on common-sense lines, and are such as can be duplicated by the ordinary farmer. I would especially call the attention of intending growers to the manner in which he selects his seed and his seed plants, and if they are carefully followed will result in stronger and healthier plants, superior quality, and prevent the rapid deterioration of the plant, so common in Australia.

The "Western Tobacco Journal" says:—

"The recent experiments conducted by Dr. Trobut, upon the selection and improvement of tobacco by means of seed selections, furnish valuable evidence for the guidance of growers of tobacco in all tobacco sections. He says that planters may rapidly ameliorate the race of tobacco they cultivate by using carefully selected seed. This choice, however, involves some precautions. *The plants should be selected with the greatest care for seed purposes, and at the time of flowering covered around the inflorescence with light closely-woven cloth. By this operation one avoids the pollination of selected plants by pollen of inferior plants.* It is also of advantage to carry on artificial pollination of the flowers on the selected stalks by carrying pollen from one to another. This operation is, to be sure, limited and somewhat uncertain, but it permits one, nevertheless, to obtain very vigorous plants of decided merit in many instances.

"The experiments carried on by Dr. Trobut at the botanical station in Algeria during four years, on the value of tobacco crosses, are an illustration of the usefulness of the practice. The object of those experiments was to unite all of the races of tobacco already acclimated in Algeria and a collection of exotic tobaccos. From the crosses of the introduced tobaccos with the best races already acclimated, there have resulted a certain number of varieties which seem advantageous for these regions. In the crosses carried on for the purpose of improving the native tobaccos, he observed that the seeds of tobacco are often badly formed and show low specific gravity. By placing the tobacco seed in water, it was observed that only one-half of the seed sunk to the bottom of the vessel. The seeds which floated on the surface of the water were nevertheless able to germinate, but gave less vigorous plants during their whole development.

"By sowing the seed which floated and those which sank, he established the fact that all of the plants grown from the heavy seed were greener, taller, and more vigorous than the plants raised from the light seed. The seedlings transplanted in the same field, alternating a plant from heavy seed with a plant from light seed, preserved their characters, the plants from the heavy seed having the more desirable leaves and producing the best plants. The plants from the light seed developed more slowly, and had a tendency to bloom before having reached sufficient development. *The weight of leaves from the plants grown from the light seed was hardly one-half that of the leaves harvested from the plants grown from the heavy seed.*

"There is no doubt that considerable advantage is to be derived from this easy selection of the heavy seed. Growers of tobacco always have an excessive amount of seed. Before sprouting or sowing this seed, they should throw it into a vessel of water, shake gently, and take out the seed

that float, destroying it so that it can not be used for planting through any possible mistake. The amount of seed that float usually represents about one-half of the seed gathered. The heavy seed may be dried and preserved, or the best plan is to make the separation just before time for sowing, and then sow immediately after this treatment. The heavy seed thus planted will give more vigorous plants, producing better leaves, but with a tendency to bloom a little later than plants grown from the light seed.

"In practice it may be found that few, if any, of the seeds sink immediately after having been thrown into the water. It seems that it is necessary for the seeds to stand for some time in the water, during which they become thoroughly moistened and will then sink. By careful examination, the moment when all of the heavy seed have sunk can be determined, and the light seed removed. Another plan for the separation of the light from the heavy seed is by the uses of sieves having such sized openings that the heavy seed will fall through and the light seed be retained and finally discarded. Cheese cloth having the proper size of mesh can be used successfully for this purpose. If it is possible to use an air blast, there is probably no better method of separation. As the tobacco seeds are very light it will be found necessary to have a very steady current of air, and of such volume that the heavy seed will fall and the light seed be carried away.

Selection of Young Plants in the Seed Bed.

"One of the important results of the work of Dr. Trobut has been his study of the effect of selection of young plants in the seed bed upon their yield and quality of the mature plants. He found that by an examination of the young plants in the seed bed it was possible to tell from the variation among the young plants the individuals which were most desirable for use and should be reserved for planting. He selected those young plants in which the side veins are at regular right angles to the midribs of the leaves. The plants having irregular veins, or other undesirable characteristics of leaves, were discarded, as he found that such plants did not develop good plants in the field. He concludes that it is perfectly practicable for the grower to study the young plants in the seed bed, and from this examination weed out the unprofitable type of plants. This point can well be taken into consideration by every grower, and by following these injunctions secure the best plants for growing in the field.

"The greatest value of these experiments is the emphasis laid upon the value of good seed. There is no more important factor in the production of the crop, and up to this time little attention has been paid to its real importance. A good crop cannot be produced from poor seed, no matter how much labour and expense is given to the growing of the crop. On the other hand, careful seed selection and the securing of

improved types and races of tobacco by hybridisation mean increased profits with little or no extra expenditure on the part of the grower. In view of the large acreage which a small amount of seed will plant, it seems that there is no crop in which practical results can be obtained so sure and with such widespread beneficial results as in the case of tobacco. Heretofore, growers have allowed the matter to work out for itself, making no direct effort to produce desired types, races, or uniformity of quantity and quality of tobacco, but the time has come, as in the case of other crops, when it is possible to decide upon the type desired, and by following the laws of selection and crossing produce the desired kind of tobacco.''

Cultivation of Tobacco.

In selecting land to be planted in tobacco, as nearly as possible it should be free from weeds and grass surrounding it, as such places serve as breeding-grounds and hiding-places for pests that may give great trouble to the farmer; it is best to have the tobacco-field between other cultivated fields, such as corn and wheat, but not near potatoes. The ground should be well and deeply ploughed during the winter, in order to destroy the insect larvæ as much as possible, and to well rot the rubbish that may be turned under; and by means of a spring-tooth harrow or a cultivator it should be kept clean until the time for planting arrives. Before transplanting, the ground should again be deeply and well ploughed, not cutting too wide a furrow—by cutting only about two-thirds of the capacity of the plough, you pulverise better; the ploughing should be fully 8 or 10 inches deep; then double harrowed, to get the ground as finely pulverised as possible.

The importance of the thorough preparation of the soil for tobacco, and the thorough cultivation of the crop in the field, cannot be too strongly impressed upon the grower. Tobacco is a profitable and valuable crop, and it should be the aim of every grower to use every means available to get the best results, which mean always a market and the best prices.

That the crop will grow and thrive in badly prepared ground, under favourable weather conditions, is true, but where the soil is thoroughly worked down and pulverised the quality of the product is much improved, as there seems to be something required by the plant, that is supplied by the soil, that is not to be obtained in sufficient quantities in coarse and badly prepared land. This has not only been demonstrated by experiments, but is further shown by the known fact that the best tobacco lands of all countries are those capable of the finest tilth. In this country, where seasonable rains do not always come at the desired time, the crop set in the well-prepared soil will be found to suffer least from the

droughty conditions that may prevail at a critical time, for the reason it will retain the moisture better than the soil that has not been well prepared.

In other words, the ground should be in the best condition possible. New ground does not require so deep ploughing as old; it also gives a lighter yield and better colour. All the land intended for tobacco should be put in condition, that the farmer may be able to transplant whenever he has the opportunity.

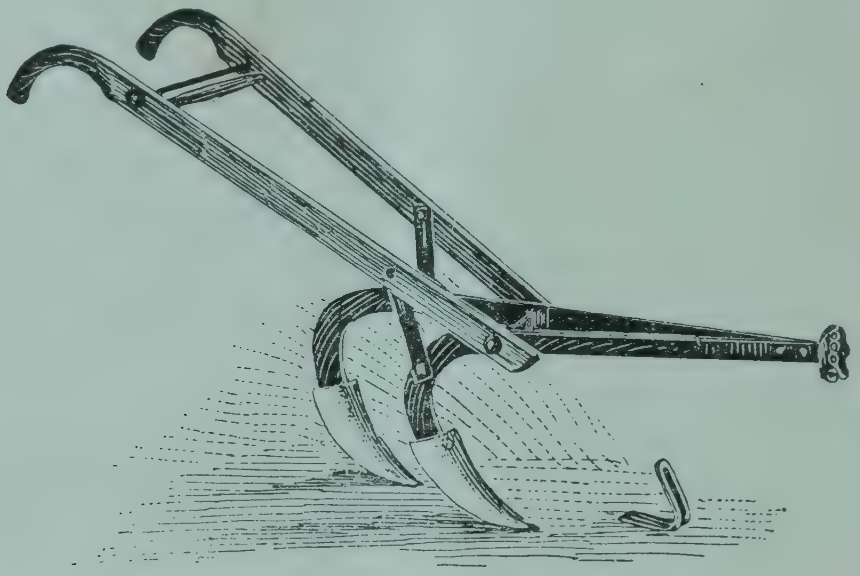
The land should be laid off 3½ feet one way, if the soil be light 3½ feet each way, but if the soil be heavy it is best to plant closer—say, 3½ feet by 2 feet. If planted too far apart in heavy soils it will grow too coarse and rank. If checked 3½ feet each way it can be cultivated both ways, but if planted, say, 24 to 30 inches in the row it can be cultivated only one way. It is best to transplant in showery and cloudy weather if possible, as then the plants will not need to be watered or covered; if such weather cannot be had, then it is best to do it late in the afternoon, beginning when the sun is about an hour high, watering the plants as you set them, and covering early the next morning; this covering need not remain more than five or six days. If your plant bed is very dry and hard, water it sufficiently to make the earth soft before drawing the plants from the bed, and it is best to leave all the dirt possible sticking to the roots; the roots should not be pinched or in any way mutilated. The plants should not be washed before setting, for they are now free of disease or insects. In transplanting, use a peg, made from a piece of broom-handle, sharpened at one end; this should be thrust into the ground deep enough to take the whole root of the plant; insert the root, and press the dirt well around it; do not press it about the stem, but let the dirt be thrown loosely about it. The plant should be well and firmly set in the ground, and this can be determined by taking hold of the tip of the leaf and pulling gently, and if the plant is properly set the leaf will break without the plant pulling out. When properly set, they will take root in about ten days; and as soon as this has taken place and the plant begins growing, go over the field with a hoe, chopping the weeds from the field and loosening the earth about the plant, and after this a man with a hoe is not worth his tucker in the tobacco patch, but do the cultivating with the plough.

The object of cultivation is to keep the soil in condition for supplying all of the plants' requirements, and not solely to kill the weeds.

No plant responds more quickly to thorough cultivation than tobacco, and probably none are more improved by it in character and quality.

The field should be kept clean and in good tilth, to promote a rapid and healthful growth. This cultivation creates a dust mulch that

conserves the moisture in the soil; it allows the air to penetrate it releases any harmful gases that may have accumulated there, keeps down weeds, and destroys the hiding places of insects. This cultivation should be frequent, and commence after the first hoeing, and continue at leas every ten days, until the tobacco is too large for the horse to pass betwee the rows without injury to the plant.



DOUBLE SHOVEL PLOUGH.

For this work a short swingle-tree should be used. The first cultivation should be deep and close to the plants before many roots have been formed, and for this a double shovel plough is the best, breaking the middle well out. This leaves the ground in good condition for the roots to spread, and gives the plant the full benefit of an ample feeding surface and no dwarfed roots.

After this, frequent and shallow cultivation is desirable with the Planet Junior for working the soil gradually towards the plant. By this gradual working the soil towards the plant, you do not create a large evaporating surface before the ground is well shaded by the plant This is essential in this State, where the hot sun and winds cause rapid evaporation.

A cloddy soil will certainly defeat all efforts to get a good and uniform stand in the field, and care should be taken to plough the ground when it is in proper condition. A tobacco-field should be ploughed after each hard rain—after the ground has sufficiently dried until the plant is too large. When the plants are kept in a perfectly healthy and vigorous conditions, they are less susceptible to disease Priming, or taking off the bottom leaves in order to allow ventilation under the plant, is also a condition to healthy fields. The amount of water in the soil to produce the best results for heavy pipe tobacco is estimated to be from 15 to 20 per cent.

"Below 15 per cent. the line of drought is reached, and the methods of cultivation should have for their prime object the maintenance of the water supply above the line of drought, so that the growth of the plant shall receive no check."—*Whitney.*

It is important that growers should take notice of these things, for when they seek an outlet for the surplus product they must offer an article quite as good as others, and one which is produced as cheaply. This cannot be done unless the best methods are adopted—the best are the most economical.

The appreciation of the necessity of proper methods, and their adoption, will save fully 25 per cent. of labour, besides giving better and increased results.

The various pests of the tobacco plant can be controlled by the use of Paris green as a spray, but this must not be used after the tobacco has been topped. It is very effective in the case of the Miner.

The lands best suited to growing heavy export or pipe tobaccos are friable and well drained. Limestone soils, with a small percentage of clay and a large percentage of silt, are the best. Wet or forcing soils will not grow good tobacco, as the product will be rank and woody.

Tobacco should be topped and primed as soon as the proper number of leaves can be secured; do not wait for the bloom. You retard the development of the top leaves in waiting too long, and the plant ripens at the bottom before the top is done growing.

Priming—that is, bottom leaves taken off—leaves you less work to do, and gives the remaining leaves the full benefit of plant life. All the leaves that are damaged should be taken off; and if none or only a few are damaged, take four to six leaves, that the remaining ones may be well off the ground, then pinch out the top, leaving not more than fourteen leaves, though most good growers prefer twelve leaves. All the plants will not be ready for topping at once, and a second topping will be necessary, when every plant should be topped if it should have only six or eight leaves. Suckers must not be allowed to grow, but taken off as soon as they appear; for if allowed to grow they seriously damage the tobacco. The above is necessary in order to have the field ripen evenly, and this again is necessary to get a good cure.

In all the work done in getting out the crop and subsequent work, the idea should be to have a field of even growth, that all may be harvested at once. An important matter for the farmer to remember is not to overcrop himself, and to know that 2 acres of tobacco properly looked after will yield as many pounds and more shillings than 4 acres that have to be neglected and that a plant topped at twelve or fourteen leaves will weigh as much as one of twenty leaves, and not so many leaves to sucker and to look after. More pounds and a better product,

more shillings and less labour, will be the result if these instructions, taken with those given in the articles on plant beds and curing, are faithfully followed.

Directions for Cutting and Curing Pipe Tobaccos.

(*See* Editorial note *re* Flue Curing.)

In cutting tobacco, if the day be cloudy, you may cut at any time; but if the sun be shining and hot, cut only late in the afternoon. Never cut or handle tobacco when it is wet, either from dew or rain. Never cut in the afternoon more than you can take up the following morning before the sun gets hot. Never cut after a hard rain, as it washes the gum off the tobacco, but wait a few days for it to gather gum again.

The tobacco cut in the afternoon may be carefully and gently laid in piles of ten or twelve plants for convenience in hanging, unless you prefer to hang as you cut.

There are several ways of harvesting the crop: 1st, by gathering the leaves as they ripen and stringing the leaves on strings or wires back to back. This method is slow and expensive, but saves barn room; 2nd, by cutting down the stalk, have all sticks made to a gauge, and a spear made to fit the end, and pierce the plant as the butt end, and push back over the stick until it is full, then remove spear and put on another stick; 3rd, this is by splitting the stalk, as in the illustration, until within a few inches of the ground. and then slightly bend the stalk over, and with a sharp stroke cut it off just below the split, so you may hang the plant astride the stick.

—Shewing how to place tobacco on Stick—

The most convenient and economical way to hang it on the stick is to sharpen the stick at one end; and, when you want to put the tobacco on it, thrust it into the ground at an angle of about 45 degrees, and then place the plants astride it.

In hanging tobacco on the stick, *it should not be put closer than four to six inches apart*, according to size of plant. If put closer than this, you will have pole burn, and many leaves that will not cure, but dry up, dead, dingy, and green. After putting the tobacco on the sticks, put it on scaffolds in the open air, and if it is thoroughly wilted—that is, leaf and stem have become perfectly limber—put it close together. It is best for it not to get rained on while on the scaffold. If this should happen, however, open it out until it dries off; then close it up again.

— Cutting—Tobacco —

If possible, the scaffold should be placed where it will be shaded from 11 till 2 o'clock.

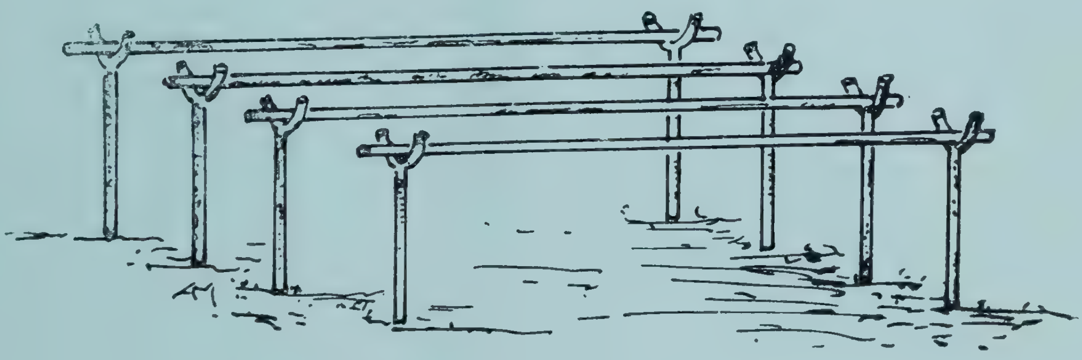
Let the tobacco hang on the scaffold from one to two weeks, if the weather is not showery or rainy, until it yellows; then remove to the barn and hang it close together, owing to size of plants, and regulate plants on sticks. Bear in mind—do not hang close on the sticks, but you can crowd somewhat on scaffold or in shed, because when the tobacco begins to dry it will leave space between the sticks for ventilation.

Now begins the most particular part of the whole process of making tobacco, for it is now that you must fix in the leaf all the desirable qualities that go to make a valuable product: strength, elasticity of leaf, flavour, &c. If you wish to air-cure, your barns should be so constructed that they can be made very close or very open as may be required by weather conditions.

If you desire to fire-cure, you want your barns closed in with plenty of ventilation around the eaves and in the gable-ends, and at the bottom of the sides ventilation that can be closed or opened as desired, that you may be able to control and regulate it.

If you desire to cure your leaf a bright colour, artificial heat is necessary, letting the tobacco stay on the scaffold and yellow, then fixing this colour with fire.

To cure with open fires, build small fires in pits over the floor of the barn, of slow burning wood, and keep them low and smothered, and keep a low temperature for the first twenty-four hours, not above 90 degrees, for a hot fire at the start will blue your tobacco. After the first twenty-four hours, if the tobacco has yellowed, raise your heat *very* gradually until by the end of forty-eight hours from the time of starting you may have it from 125 degrees to 135 degrees. After that, you may safely go to 160 degrees or 170 degrees. Keep careful watch of fire night and day, until the leaf and above half or two-thirds of the midrib or stem are cured, and then draw your fires, and allow the barn to cool. In a few days (from the sap left in the stalk and stem) you will find your tobacco has become soft, and the colours that were irregular before have run into each other, and formed a solid colour over the leaf. When this has taken place, then again build your fires, and continue them until the stem and stalk are entirely cured, when you will not need to fire more, unless there should be a continued rainy spell and your tobacco gets very soft, when a little fire to dry out the barn will do good.



—Scaffold—

If you prefer to air-cure your tobacco, then, as before stated, your barn should be so constructed as to be very close or very open, as the season may require, and always with plenty of ventilation at top, that hot air may get out of the roof.

After scaffolding, hang in your barn as heretofore directed. In cool, pleasant weather, and at night, keep your barn open to the fullest. In very hot weather, especially when winds are blowing, or in foggy weather, keep your barn closed.

If the weather be showery, with intervals of sunshine, you may keep them open; but if the weather be continuously wet and muggy, close them; and if you find your tobacco getting very soft, with a tendency to mould, build a little fire to dry out the barn.

The idea in curing by air is to keep the tobacco curing uniformly all the time, neither too fast nor too slow; and the opening and closing the barn must be regulated with that idea.

In curing tobacco with fire, the tips of the tobacco leaves should never be nearer the fire than 5 feet.

CURING SHED. OLD STYLE.

Tobacco is ripe when it grains up, and shows brown spots on the leaf, and shows a rough surface, and is very brittle, breaking readily when doubled up.

It should never be allowed to stand until the points of the leaf begin to dry up, for then it is beginning to lose weight, and is too far gone to make a good cure.

At all times be careful not to get your tobacco dirty, for dirty tobacco has no value.

Be careful in handling not to bruise the leaves, for bruised tobacco will not cure properly. Good tobacco can only be made by good curing, and good curing can come only by painstaking and experience and close observation. It is a profitable crop if well done, and, like all other things, if you do not try to do it well, had as well be left alone.

Handling Heavy Pipe Tobaccos.

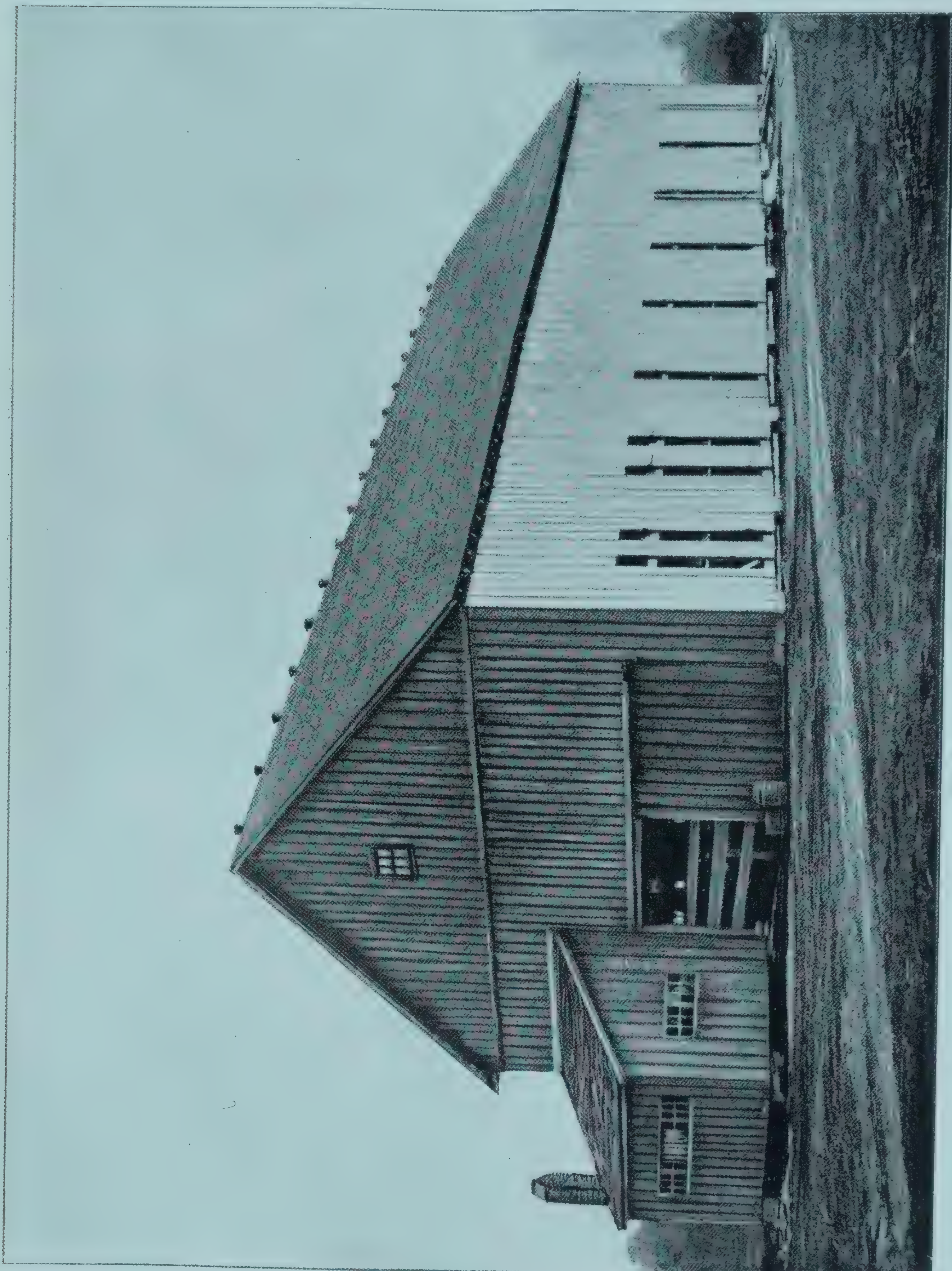
Many farmers seem to think that the period of careful management is over when the harvest time has come, when really it is the time for greatest care and intelligent work. Open sheds are not the best; the tobacco is thus exposed to all sorts of weather, and conditions cannot be controlled; it cures unevenly and irregularly, producing many sorts in the one shed. Tobacco has not finished its cure as soon as dried out; it still retains objectionable matter that must be either modified or eliminated altogether, and this is accomplished by continued hanging.

Heavy tobaccos put into the bulk as soon as dried do not have the aroma that is in those that have been hung for two or three months longer. It may be stripped and put into hands, but should be re-hung to finish the cure; in fact, it is preferred that it should be stripped soon after it has dried.

In stripping, the green or greenish should be put in hands to itself, and they should be small, not more than twelve or fourteen leaves each, and hung where light and air can get to it; if the hands are large, the leaves in the centre will not bleach out, but remain green. It is best to tie all of the tobacco in small hands, as it will continue the cure more uniformly, can be ordered more regularly, and handled more neatly.

Assorting should be carefully done, that the tobacco may have a uniform appearance, care being taken to put nothing with the best grade, or No. 1, that does not belong there; carelessness in this often causes a low figure to be paid for it, and *sometimes gives trouble with the purchaser, when he has to reassort it.* Every hand should be tied with a leaf of the same colour as the tobacco in that hand, not necessarily a good leaf, but the hand should be and look uniform. Please the eye and you please the purchaser, and the grower that establishes a reputation for neat and proper handling of his crop always gets top prices, for all the buyers want his tobacco, as it gives them no trouble.

Before bulking, it should be thoroughly dried out in the heads, and bulked as it comes into condition, and not when it is drying out, for then the stem may be surcharged with moisture that will be taken up by the leaf, and the whole get too soft and funk.



OPEN FIRE AND AIR CURING-SHED, MODERN STYLE.

The proper condition for bulking is when it is just pliable and the midrib or stem will snap halfway down the leaf. The proper condition can be determined by taking the tails in the hand and squeezing them together; if they fall apart slowly after removing the pressure, it is right for bulking, but if they stick together it is too soft, and had better be left hanging.

In bulking, the floor should be well off the ground, and so arranged that the dampness arising from the ground cannot penetrate through to the tobacco. The bulks should be large, not less than 8 or 10 feet wide, and as long as may be convenient; this allows the tobacco to sweat uniformly and continuously, not being disturbed by weather conditions; whereas narrow bulks sweat fitfully, some days lightly, and on other days not at all, owing to the state of the weather. This is important, as tobacco that does not sweat properly does not develop desirable qualities. The bulk should be well covered at sides and on top.

The bulking should be done about the time summer weather is beginning, that the tobacco may not be chilled when it goes in the bulk, and the weather conditions can be depended on for favourable results.

It should remain in bulk four to six weeks before prizing. It must be borne in mind that the sweating of these tobaccos is an entirely different process to the sweating of cigar leaf.

Cigar Leaf.

During my visits to Northern Queensland, I have examined carefully much of the soil, and am of the opinion that a great deal of the land is suitable for tobacco-growing. More especially is the land from St. Lawrence to Mackay, about Bowen, and on the Lower Proserpine, especially on Kelsey Creek, very desirable for the purpose, on the Burdekin and in towards the coast from Woodstock.

As the climate has quite as much to do with the production of good tobacco as the soil, *we cannot fully determine* whether or not these factors will produce a superior quality until the experiment has been tried. It HAS been tried in a very small way at the Proserpine and on the Murray, and *the results were most satisfactory*, sufficiently so to demonstrate that those who will take up tobacco-growing in these two districts, and who are careful and painstaking, will get satisfactory results. The experiment is certainly worth trying, and those who are first in the field to make a success of it will be richly rewarded for their labour.

Good cigar tobaccos have always been scarce, and fetch high prices in the world's great markets—prices that will justify hiring labour for the work.

Sydney and Melbourne are large buyers of cigar leaf, and if a superior leaf is grown here a market can be found for it; but intending growers should remember that buyers want good tobacco—the world is

full of worthless stuff, and to make it good requires care and faithful attention to every detail.

For the information of those who may desire to try the experiment, a few suggestions for their guidance will be of assistance, and I will state that nothing is hereinafter written but what is important, and should be carefully noted and followed, for failure is almost sure to result if the instructions are not fully adhered to in every particular.

To grow tobacco successfully and profitably cannot be done in a haphazard way, and those who attempt to grow in such a way must meet with disappointment and loss; on the other hand, tobacco is one of the most profitable crops grown if properly looked after.

Some things can be done in almost any fashion, but tobacco-growing is not one of them.

Soils.

The soil should be a warm, sandy alluvial one, well drained, and rich in humus or vegetable matter—a soil that is friable and capable of the finest tilth, and such a one as will retain its moisture. The content of clay should be small, or absent almost altogether, though a clay subsoil is not objectionable, but clay in the soil tends to make the leaves thick and gummy, which is objectionable in cigar leaf. The land to be planted should be at least 5 miles from the sea coast, that it may not be affected by the sea air, which injures its burning quality.

Ground should be prepared as heretofore directed.

When to Plant.

It is best to plant at a time when the harvesting will come on at the end of the rainy season as near as may be, and, in order to determine that, it must be remembered that it will take from six to eight weeks from time of sowing the seed until the plants are large enough to transplant. This is the usual time, though sometimes, under favourable conditions, one month is sufficient. After transplanting, when the plants have taken root, they will take from sixty to seventy-five days to mature.

The reasons for harvesting at the time mentioned are—that it is desirable to have the plant growing at a season when there is a humid atmosphere, which greatly improves the texture of the leaf, and that it is not desirable to have the hot drying winds while the tobacco is curing, as it will then be subject to changing conditions that make it green and splotchy, and the leaf is liable to be harsh and dry, whereas it should be soft and flexible.

Tobacco should never be hung in open sheds, but in closed-in, well-ventilated ones; neither should it be exposed to hard drying winds, either in sheds or fields; hence fields should be as much sheltered as possible.

Sheds should be built so as to prevent too rapid changes in the temperature, and so that the temperature will not get too high and cause

too rapid drying; hence, iron for roofing or sides is very objectionable. A good thatched or board roof should be used, and for the sides the same material, so arranged as to be able to ventilate freely when required.

Making, sowing, and treatment of seed beds is the same as directed under the head of Pipe Tobaccos.

Transplanting.

This should be done late in the afternoon. The rows should be 3 feet 6 inches apart, and the plants placed 18 to 22 inches apart in the rows. Select strong healthy plants with good lengthy stocks, and set them well down in the earth, pressing the dirt well to the roots. By having long stocks and setting the plants deep, the roots rest in the moist earth and will thrive better. In drawing the plants from the seed beds, it is best to take a three-tined steel table fork and raise the plant with it. This leaves a good bunch of earth clinging to the roots, and enables the plant to take root better. *Transplanting should be done after rain, or in cloudy weather, as much as possible; but if the weather be dry, water should be used to set the earth about the plant, and early next morning a light covering of grass should be put over each plant before the sun is up. If the weather continues dry for some days, it will be necessary to water the plants occasionally until they take root. This can be done by using a bucket of water and a cup. Pour about a pint over each plant. This should be done about sundown; it is not necessary to remove the grass covering when watering.*

In setting the plant, scoop out with the hand some of the earth so as to make a depression around the plant. This serves to keep the water from running away from the plant, and also, when the grass covering is laid over it, it will not press it down. The depression should be made deep enough to leave the plant standing erect when the covering is put over it.

Cultivation.

Clean cultivation is necessary. After the plants have taken root, the field should be gone over with a hoe, the earth loosened about the plants, and the weeds chopped out. When the plants are 3 or 4 inches high, a Planet Junior with the small points should be run between the rows. The Planet Junior should be well opened out, and run as close to the plant as possible without cutting it up, and it should be run to its full depth to form a loose root bed that the roots may run and not be dwarfed.

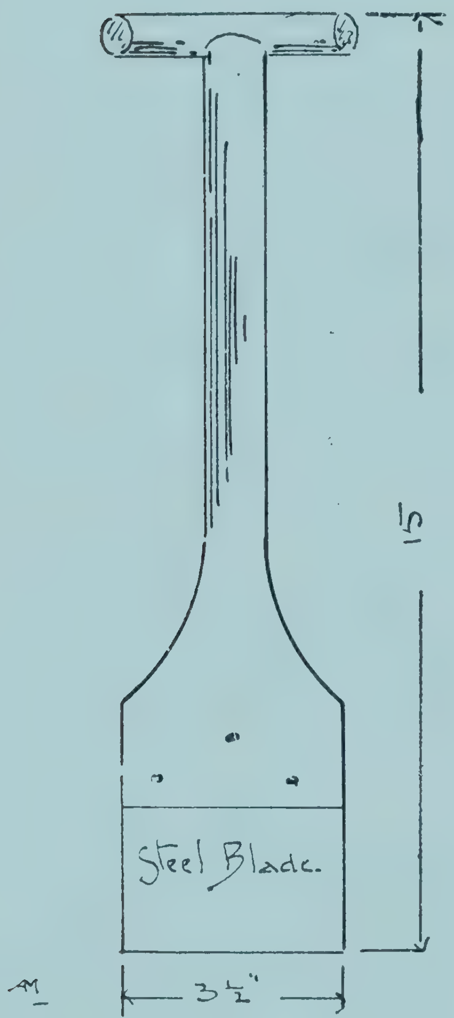
This ploughing should be done every ten days, but not run so close to the plant nor ploughed deeply until the plants are 12 or 15 inches high. Then a pony turning-plough with one horse should be used for hilling up. When this is being done, the plough should not run closer to the plant than a foot.

The tobacco should be kept free from grubs. The time to look for these is early in the morning. Later on come the topping and priming,

which should be done promptly when the time arrives. Topping is pinching out the seed bud, and priming is breaking off three or four bottom leaves to let the air circulate under the plant. Topping and priming should be done at the same time; and after this is done, there should still remain on the plant eighteen or twenty leaves.

Do not let your plants flower, except such as you want for seed. After topping, suckers will shoot up from the base of the plant and where each leaf joins the stalk. These should be kept broken off, and not allowed to grow to any size. Suckers will have to be taken off two or three times before the crop ripens.

Harvesting.



Knife for Cutting Tobacco—

Tobacco should not be cut until fully ripe, but it should not be allowed to get over-ripe. It is ripe when the leaf begins to droop, and shows a rough surface and brown spots appearing on it. In the early morning, if the ripe leaf is folded it will split along the fold. Cutting should not be done in the heat of the day if the weather is hot.

The stalk should be split to within 6 or 8 inches of the ground, and then cut off at the ground, gently laid down with the butt towards the sun. Let it lie until it is thoroughly wilted, which will take from thirty minutes to an hour, according to the weather. After it has wilted, hang it astride a stick. Other methods of harvesting are practised, such as spearing the stalk, also gathering the leaves and stringing them; but the above is the simplest to beginners. In hanging on the stick, each plant should occupy a space of at least 6 inches to prevent crowding—that is, fully 6 inches between the plants.

For convenience, a scaffold can be erected on the field, and the sticks of tobacco hung on it for two or three days until thoroughly wilted; but it is better to take it to the shed if convenient to do so, and hang it on the lower tiers; but, if a scaffold is necessary, it should be made under the shade of a tree so that the *hot* sun will not shine on it. Care should be taken that no rain falls on it after it is cut. Tobacco should never

be cut when wet from either dew or rain, and after a good rain should not be cut for three or four days, unless it is already fully ripe.

When taken to the shed, the sticks must not be hung too close together, but so placed that the tobacco on one stick barely touches he tobacco on another. It should be opened out well on the sticks. If this care is not taken, it may house-burn and stem-rot, either of which mishap destroys its value.

After hanging in the shed, give plenty of ventilation for the first two or three weeks, but protection from hard winds must be afforded. After this time so much ventilation is not needed, but it is not advisable to have the shed too close.

In curing tobacco the conditions should be as uniform as possible, or any changes should be very gradual.

Fire should not be used in curing cigar tobacco, except when the weather continues wet and it is likely to be damaged, and then only for an hour or two at a time; then stoves should be used for drying-out the shed, but the pipes should run outside and no smoke allowed to get on to the tobacco; or charcoal pans may be set on the floor after the smoke has burned off.

Selecting Seed Plants.

In saving seed, care should be taken in selecting plants that are strong, and that each seed plant should show the same characteristics. By this is meant same shaped leaves, equal distance on the stalk, growing in the same position, &c., &c. This is necessary if you are to keep the type, and this you will understand when it is noted that when tobacco seed is introduced into a different locality its tendency is to break up into various types, and eventually to establish a type that would naturally be peculiar to the country; hence, by carefully selecting a type for a few years, we are enabled to fix it. It is a good plan to save enough seed one year to last for three or four years. By this means you do not get away from the original so readily, if a mistake is made in selecting the seed plants. When the plant seeds, allow only one head to run up, cut off all branching heads, so as to allow only fifteen or twenty seed pods to form on the central spike. By this means the whole growing strength of the plant is thrown to these few pods, and strong healthy seed is formed. This is important.

Do not strip the leaves from the seed plants until the seed has fully matured. When the seed has matured, cut the stalk off 5 or 6 inches below the seed pods, and hang head down in a dry place until the pods are thoroughly dry.

The cigar-leaf industry is a valuable one, and, if once developed in this State, will be found to be exceedingly valuable to the small grower, especially to those farmers who are at some distance from shipping points and have to haul their produce considerable distances. To such

farmers I especially commend the crop; at the same time it is a profitable crop to all farmers when a high-grade leaf can be produced, and I feel satisfied that a high-grade leaf can be produced in the districts I have mentioned; and it is sincerely to be hoped that the effort will be made by some of the farmers in these districts with the view of growing it commercally as a regular crop, and not as a curious experiment.

Intending growers can secure suitable seed from the Department of Agriculture and Stock. Address the Under Secretary. Always state whether cigar or pipe tobacco seed is desired.

Pipe varieties—White Burley; Broadleaf Gooch; Connecticut Broadleaf; Blue Pryor.

Cigar varieties—Cuban; Havana.

Fermentation of Cigar Leaf.

Cigar tobacco is never suitable or ready for making cigars until it is fermented, at least to a sufficient degree that some idea can be formed by the buyer of its flavour, and while this is often done by the manufacturer, when it is possible to do so, and especially when the tobacco is put on the open market, the grower will find it to his interest to do it himself, and in order to enable him to do so I give some directions for bulk sweating.

This should be done in warm weather or a warm room. It is best to have a raised floor that the air may circulate well under it. The tobacco should have a moisture content of about 23 per cent. to 25 per cent. It should be bulked not less than 1,000 to 1,500 lb. in the bulk, more if possible; bulk should be made wide enough (say, 6 feet) and long enough (say, 8 or 10 feet) so that weather changes will not affect its sweating. It can be either bulked or placed in bins, but in either case it must be closely and well covered, sides and top. Before commencing the bulk, spread tobacco trash and broken leaves over the floor 5 to 10 inches deep, and on top of this smoothly and carefully bulk the tobacco. As the bulk goes up place large hollow bamboos in the bulk near the bottom, in the middle, and near the top. Let one end of this bamboo rest near the middle of the bulk and one end project, and in these thrust thermometers full length so they will rest near the centre of the bulk. These thermometers should be examined twice a day, and when the temperature reaches 135 to 140 degrees, then break the bulk down and rebulk it, being careful to take sides, top, and bottom tobacco and put in the centre of next bulk, and the centre of bulk on outside, top, and bottom. This is called reversing. This breaking down and rebulking will have to be done several times until the temperature ceases to go so high, but when it has reached a point under 135 degrees and then begins to fall, then the sweat is finished. No. 1 and No. 2 tobacco can be sweated in same bulk, but must be kept separate. It is best to bulk the tobacco when the weather is rainy and soft, and it has become quite soft from the weather. When rebulking, always shake out the tobacco well.

APPENDIX A.

Tobacco: The Production of Light-Coloured Pipe and Cigarette Leaf.

(Reprint of Bulletin issued by the Department of Agriculture, New South Wales.)

C. J. TREGENNA, Tobacco Expert.

Soils.

A light, friable, sandy loam is the most suitable for the production of a good quality tobacco that will give the desired aroma, texture, and colour. The plant is, however, easily affected by climate and by the chemical and mechanical conditions of the soil. Bright-coloured tobaccos are usually produced on light-coloured soils, and dark leaf on dark soils.

The presence of clay has a great influence on the product, and it will be found that a proportion of 8 to 10 per cent. of sand to one of clay is most likely to produce bright or yellow tobacco. Large proportions of clay will produce a tobacco which cures out a dark colour.

The subsoil is another important factor. It is desirable that it should underlie the soil at a depth of about 12 to 18 inches, and that it should contain a larger proportion of clay than the soil above. It is found that where the subsoil is too near the surface the tobacco is inclined to cure out a darker colour. On the other hand, it must not lie too deep, for the sandy nature of the surface soil may allow moisture to get beyond the reach of the plants, which may thus suffer from insufficiency of moisture should a dry spell occur during the growing season. Thus the subsoil should lie neither too near the surface nor too deep, and within 18 inches of the surface is most satisfactory.

In new localities the suitability of the local and climatic influences should be determined by experiments before tobacco-growing on a large scale is attempted. It is not advisable to attempt to grow the crop within 10 to 15 miles of the coast, as the "burn" of the tobacco is injuriously affected by the presence of chlorides in the atmosphere and soil. The land should be well drained, and the soil as free as possible from weeds.

Preparation of the Ground.

The land should receive a thorough ploughing early in the winter, and as soon as weeds appear thereafter, or a crust is formed on the surface, the spring-tooth cultivator should be used. The operation will not only kill the weeds, but will conserve moisture and sweeten the subsoil. Shortly before the season for transplanting, a second ploughing should be given to a depth of 9 inches, and the soil harrowed to produce a fine tilth, so that the rootlets of the tobacco plants may be hampered as little as possible in their search for nourishment.

As tobacco should arrive at maturity in two to two and a-half months after transplanting, the grower requires to give careful attention to the preparation of his ground. With anything like unfavourable soil conditions the rapid and healthy development of the plants is bound to be interfered with, and it should be the concern of the farmer to do all that is within his power to prevent such a state of affairs.

Working-up the Seed-beds.

In the growing of tobacco, care and trouble in the preparation and subsequent treatment of the seed-beds are amply repaid.

The last week in August is early enough to start sowings of seed, and this should be continued at regular intervals of a week or ten days up to the first week in November, so that the grower may be assured of a sufficiency of plants whenever the weather is favourable for their removal to the field after danger from frosts is past.

The site chosen for the seed-beds should be in a position sheltered from prevailing winds, and the soil should be a well-drained, rich, sandy loam. First mark off beds 4 feet wide; then pile a quantity of timber and brush-wood on the surface, and start a fire on the leeward side, the intention being to raise sufficient heat to kill insect eggs and seeds of any weeds that may be present. Rubbish of any size should be raked off, but the fine ashes should be left, as these will act as a fertiliser when worked into the bed. Then the surface should be broken to a depth of 5 or 6 inches, and worked up to as fine a tilth as possible. The bed should be enclosed with a frame-work of wood. If squared timber is not available, straight logs about 6 to 9 inches in diameter will answer the purpose.

To Ensure even Sowing.

To ensure even sowing, one level teaspoonful of seed is sufficient for a bed 4 feet wide and 25 feet long, and should yield enough plants for 1 acre.

Do not attempt to sow the seed without addition to its bulk, but get two buckets, one of which should be about one-third filled with fine ashes. Place a thin layer of ashes in the empty bucket, and sprinkle as evenly as possible a pinch of seed over it; add another layer of ashes, and mix well. Repeat the process until the quantity of seed it is desired to sow is used up, together with the ashes. Give it a good mixing again with the hands. The early morning will probably be found the best time to sow the seed, before the wind becomes troublesome. It is inadvisable to sow with a strong wind prevailing, if it can possibly be avoided, as the seed is so light that it will be blown away. The mixture of ashes and seed should be distributed over the bed as evenly as possible, and the colour will be a guide as to its even-ness. The seed should not be raked in, but after sowing the bed should be gently firmed all over with a piece of flat board. Then lightly water the bed several times with a can that has a fine rose. Do not put on so much at one time that it will run in small streams, but moisten the bed thoroughly.

Raising the Plants.

It will now be necessary to cover the beds for protection against cold, the sun, and insects. A simple plan is as follows:—At each end of a bed drive one small post, leaving it about 12 inches above the ground level, and strain a length of No. 10 wire from one to another, so that it runs down the middle of the bed; place a few small posts along the bed to take up any sag. Attach to the wire white hessian or cheese-cloth. This may be stitched

to the wire tightly with binder twine or string with the aid of a packing needle. The covering should be stretched tight and fastened to the sides by hooking over nails.

As it is advisable to have plenty of plants at the right stage when required, provision should be made for 50 per cent. more beds than are apparently necessary. One hundred square feet of bed is sufficient for an acre, but the bed will require to be pulled over a period of a few weeks, and the grower should not miss an apportunity of getting out as many plants as possible at one time when the weather conditions are favourable. Then, too, the danger from loss of plants by destruction by insects and other causes must not be overlooked. Over a number of years, the grower will find the average of 50 per cent. extra will amply repay him.

If the soil is inclined to pack after sowing, scatter over the bed very lightly some fine, well-rotted horse manure. If it is anticipated that the soil is likely to pack in this way, the manure should be incorporated in the bed before sowing.

In about one month the beds will be ready to be uncovered, and the seedlings to be hardened off before transplanting. This should be done gradually. For the first few days, if the weather is very hot, cover up in the middle of the day until the plants can stand the direct heat of the sun.

Plants which come up too quickly in the seed-beds are apt to be weedy and spindly specimens, and should be thinned out so that each occupies an area of about a square inch.

If plants are not coming on as fast as it is wished after they are up, a sugar bag may be filled with horse-manure, the neck tied, and the bag soaked in a cask of 40 gallons of water for a day. The liquid can then be freely used twice a week on the beds with a can that has a fine rose.

Pests of Seedlings.

The beds should be covered every evening and not uncovered until sunrise. Possibly the grower has not been troubled with the moths which lay eggs on the seedlings and develop into the caterpillars commonly known as "Stem Grubs" or "Tobacco Leaf Miners," and which work their way through the leaf tissues into the stem and stalk, and it is well to take some precaution. If the grub is present, or feared, spray the plants when they have four leaves with two teaspoonfuls of arsenate of lead to 1 gallon of water, and at an interval of four days later repeat the spraying.

Look out for cutworms, as they work havoc in the beds if neglected. If their presence is suspected, for two evenings before sowing lay baits on the seed-beds and the surrounding cleared land. The bait is made with 1 lb. arsenate of soda, 8 lb. treacle or sugar, and 10 gallons of water. Dissolve the arsenate of soda in 1 pint of boiling water, add the sugar or treacle, and the water, cut up some greenstuff, and mix all together. Pollard also may be used in place of greenstuff, and, if so, it should be mixed to the consistency of porridge. The quantity mentioned should be enough for the seed-beds for 10 acres of plants.

To Hasten Development.

Possibly it is required to obtain plants quickly, and in the following manner growers may expect to have them ready for transplanting in about six weeks. Before sowing, lightly cover the whole bed (so that it may be plainly seen) with high-grade superphosphate; about 3 or 4 lb. will be

required for each 100 square feet of seed-bed. Take a rake and **lightly** draw it over the bed once, and then sow the seed. When the plants are well up (which should be in about three weeks), soak a sugar bag full of horse manure in a 40-gallon cask of water, and give the bed a good watering. This should be repeated weekly. Plants so grown will do well in the field, but it must be understood that the grower **cannot** obtain plants quickly if the ground is not warm and the weather spring-like.

Keep the beds moist, but not wet, until the plants are well established. It is important that the beds should never be allowed to become dry on the surface while the seed is germinating. After the plants have reached some size it is better to thoroughly water occasionally—not too often, but **thoroughly** when it is done. This will reduce the danger from mould.

No fixed rule can be given for watering, but do not water beds which are uncovered while the sun is at all strong.

Transplanting.

When the plants are from 6 to 8 inches in height and well hardened off, they are ready for setting out. Plants which are stunted and yellow, and which have long pointed leaves, should not be used. The best are those which are most vigorous looking, and with short, broad leaves. If the beds are dry and hard they should receive a good soaking some little time before the plants are drawn, as it is necessary that as little damage as possible to the root system takes place, and the earth adhering to the plants should not be interfered with more than can be helped.

The best way to remove the plants is with a three-pronged fork. If the tap-root is long, it should be trimmed off with a pair of scissors to about 2 inches. The less handling the plants have the better, and after they have been drawn they should be placed, root downwards, in a cool place, and kept covered with wet bags. Only the plants that can be set out on the same day should be drawn at the one time.

It may here be stated that where the aim of the grower is to produce a fine-textured leaf, the plants should be set out close together, and although past experience must be taken as a guide, it will generally be found that a space of 2½ feet in rows 3 feet apart on light sandy loam will not induce heavy growth and coarse texture. This distance of 3 feet between the rows will allow of horse cultivation, and thus lessen labour.

A simple and effective way to mark out the land is to attach four light chains spaced 3 feet apart on a light pole with a handle, so that a man can drag it behind him and walk in accordance with sighting poles fixed for that purpose.

The ideal weather for planting out is just before and during rain, so that the roots of the plants may have very little check, and growth may be established as soon as possible. Unfortunately, however, weather conditions do not always suit the planter, and possibly owing to the lateness of the season he is forced to set out during dry weather. In this case holes should be made and filled with water, and the plant carefully put in and the earth well packed round the roots. Care should be taken that the roots are not doubled up, and that the hole is properly filled with earth. A simple test is to pull the tips of the two top leaves gently in an upward direction, and if they break off in the fingers they are right. Another method where irrigation is not carried out, is to make a hole close to the plant and fill with water, and then cover up to prevent evaporation. If the weather continues hot after transplanting, the plants should be shaded with grass. Paper folded in the shape of a tent and

held down by two clods of earth is also very effective. It may be necessary to water, and, if so, it is best done early in the morning or about an hour before sundown. Plants which have struck well usually start growing in about ten days, and the covering may be removed.

If irrigation is carried out, a good plan is to turn two shallow furrows together with a light plough, and run the water so that the ridge gets a good soaking some little time before transplanting. The plants should then be set out on the shady side of the ridge, care being taken that the stem and leaves are high enough above the water to avoid being submerged.

As soon as possible after transplanting it is advisable to run water through again to set the earth well round the bottom of the roots. After five or six days the crust around the young plants should be lightly stirred and broken.

Cultivation.

Tobacco quickly responds to cultivation, and the grower should aim at keeping his land in fine tilth, and free from all weeds up to the time the plants are ripening. During dry weather, by creating a dust mulch, excessive exaporation of moisture is avoided. The root system of the tobacco plant is largely near the surface, and for that reason shallow cultivation must be practised. As soon as a crust is formed, or the ground becomes hard, get to work with the horse cultivator and hoe, and when the plants are high enough, arrange the tines of the cultivator so that the earth is gradually drawn from between the rows towards the crown of the plants. Pronounced ridging will induce the drying-out of the soil, and should be avoided. Neglect of cultivation shows itself very clearly in the value of the tobacco, and no plant is so easily affected. It may be stated generally that the crop should receive a thorough cultivation every week or ten days after the plants have started growing until such time as the horse cultivator cannot be used without damaging the leaves of the plants owing to their size.

Where irrigation is carried out, cultivation must take place as soon as the ground begins to harden or crust. It is useless to water alone if good results are expected.

The bottom leaves are almost invariably damaged and dirty. These, generally numbering from four to six, should be removed, and the sap will then be taken up by the remaining leaves, which will be well off the ground.

Topping.

When the flower head or inflorescence has started to develop, the top length of stalk must be broken off. Plants which are strong and vigorous are topped high, and those which do not present these features are topped low. Experience and a fine judgment is necessary to determine the number of leaves that should be left on a plant, but for a normal season twelve to fourteen would seem to be about the number that should be left to mature. Where the entire plant is to be harvested, the planter should aim at obtaining as even ripening as possible to enable him to secure a good uniform cure and quality of product.

Suckering.

Soon after topping has taken place, and sometimes before, suckers will appear at the junction of the leaves and at the bottom of the stalk. As soon as they are about 2 inches long, or large enough to be conveniently grasped, these must be removed. Care must be exercised that in breaking them off the remaining leaves are not torn or damaged. It will be found that early in the morning is the best time to carry out this work, as during the afternoon of a

hot day they are tough and leathery. The operation of suckering will most probably have to be repeated each week. Particular attention should be paid to this work, because if suckers are allowed to go far, the quality of the tobacco will be seriously impaired.

Harvesting.

Some three to five weeks after topping, maturity will be reached, and there will be various indications that the time for harvesting has arrived. The varieties which have been distributed by the Department, if planted under suitable conditions, on reaching maturity, should show lighter shades of green, a golden sheen when looked at in certain lights, and in some cases a yellowish blotchy discolouration, or yellow spots. When the leaf is folded between the fingers, too, it will crack across.

Plants should not be cut or handled while the dew is still on the leaves, or after rain, until the gummy feeling has returned to the leaf.

There are several methods of harvesting.

The "Priming" Method.

It will be observed that all the leaves on the plant do not ripen at the same time, but in all cases they start to mature from the bottom upwards. To secure the best results, and obtain an even cure, each leaf should be taken off separately as it reaches maturity.

The leaves are then placed in baskets or other suitable receptacles and taken straight to the barn to be strung in the shade, care being taken that after "priming" they are kept out of the sun as much as possible. The leaves are then made up into "hands" containing four in each. A 4-feet stick will take about twenty "hands," ten on each side. In each "hand" of four leaves two should face one way and two the other, the middle two having their backs together. When the tobacco is to be flue-cured, the "hands" should not be jammed up close together, but there should be a space of a few inches between each on either side of the stick. Where air-curing is practised, the leaves should be placed **close** together until they have assumed a yellow colour, after which they should be opened out as above.

The method of stringing it is somewhat difficult to describe. The stem-butts on each "hand" are strung with a twist of the string to hold them together. The string, which is about twice as long as the stick, is held fast permanently at one end by being pressed into a slit in the wood, and when the required amount of tobacco has been strung, the loose end of string is run through another split at the other end, and made secure. The grower quickly finds out how it is done, after a trial or two.

Hanging may also be carried out by threading each leaf with a needle and twine through the midrib, but the process is a tedious one. Yet another method is to put fixed wires through the curing stick, so that they project 5 inches on each side, and are 7 inches apart. The leaves can be hung on the wires by piercing through the stem-butts. Leaf so strung is very liable to damage by tearing when the stick is being handled, and it is not possible to bulk down without removing the leaves from the wires.

Harvesting the Whole Plant.

When the whole plant is to be harvested, a fine discrimination must be shown in order that the largest proportion of leaves shall be at the right stage to ensure a satisfactory cure afterwards. As stated above, the whole of the plant does not ripen at the same time, and where the whole plant is to be

harvested and cured it must be cut when the middle leaves have matured. The plant should be split down the middle to within a few inches of the bottom, and then chopped off and placed astride the curing stick. The stick must be carried so that the leaves will be clear of the ground, as otherwise dirt may adhere to the leaves and depreciate their appearance and value.

The Method Recommended.

A combination of the two harvesting methods—the "priming" method and the whole plant—is recommended to growers as productive of satisfactory results without the labour involved by "priming" throughout. When the bottom leaves of the plants have come to maturity they should be primed off and strung, and the upper leaves left until they are ready, when they should be taken off with the stalk attached and strung, as in the case of harvesting the whole plant.

Curing Tobacco.

With very few exceptions, the methods of curing adopted in this State are not such as ensure the best results from the leaf as grown. It should be understood that mere cutting, scaffolding, and hanging in an open shed can never be expected to give good uniform results. Leaf so treated is just dried out. This State is subjected to rapid changes of climatic conditions, and tobacco which is left solely to the wiles of the weather invariably suffers.

What is termed "sun and air drying" has in the past been the method usually adopted, but it has rarely produced the bright or yellow tobacco now sought for by the manufacturers. Local buyers state that Australian tobacco so dried has an aroma which is peculiar, and not agreeable. Tobacco which has a pleasant aroma is usually agreeable to the palate; and it is this the grower has to cater for. All our remarks must be taken to refer to the curing of the bright and yellow tobacco, which it should be the aim of every grower to obtain.

Air-curing.

As tobacco is so easily affected by climatic conditions and rapid changes of temperature, it is necessary, if the leaf is to be air-cured, that the grower should have at his command a building which can be closed up or opened, as becomes necessary, and the ventilation of which can be perfectly controlled. In continuous wet weather the grower must be able to allow a current of air through his barn; and if dry, hot weather prevails, it must be possible to close the building up completely to prevent too rapid drying of the leaf, or to open the ventilators during the nights. If the leaf is showing signs of fungus, or "pole burn," and the weather is wet, charcoal or corncob fires should be placed in the barn, and the ventilators opened until the excess of moisture has departed.

Sun and Air Drying.

Where curing is effected by means of an open shed, as is the usual custom in this State at the present time, the tobacco should be cut late in the afternoon, and hung on the sticks close together. When it has wilted it will be possible to pack much closer. A scaffold should be erected close to the shed, the sticks of tobacco placed close together, and allowed to remain so until the leaf has assumed a yellow colour. When this change of colour has taken place, each stalk should be separated by a space of about 6 inches, and the stick taken to the barn. Growers should note that in the barn the sticks must have sufficient space to allow a free current of air to pass through the tobacco;

it is a great mistake to let the leaf be crowded together in the shed. Tobacco which shows every promise on the scaffold of securing a good colour is often spoilt by neglect of this precaution, and the result is a dark and dingy coloured leaf.

There is another point which growers would do well to observe: they should see that when on the scaffold the leaf does not get burned by the sun. If it is not possible to place the scaffold in such a position that it will be shaded during the middle of the day, a covering of cheese-cloth should be passed over all the leaf to break the rays of the sun, so that it may go into the barn of a yellow colour instead of a dark-brown. Tobacco on the scaffold should **never** be allowed to get wet; and a good cure cannot be expected if this happens.

Flue Curing.

To successfully flue-cure leaf, the grower must have considerable experience. Few barns of tobacco can be cured alike, and almost every one requires different treatment. In a very short space of time a barn full of leaf may be totally spoiled through neglect, lack of knowledge, or a little bad judgment.

To cure in this manner special buildings are necessary; they must be draught-proof, and so finished that heat and moisture cannot escape; and they must be erected of materials which will permit the interior to be affected by outside temperature to only a minimum degree. Iron erections are, therefore, totally unsuitable, while brick is expensive. It is suggested that the building should be erected of wood or pise. The inside dimensions of a building suitable to cure the crop of 6 or 7 acres would be 16 feet by 16 feet, and 17 feet high, with a spacing of 3 feet 6 inches vertically between the tiers on which the sticks of tobacco are hung when harvested on the stalk, and 2 feet when the leaves have been "primed." Two furnaces should be provided at one end of the building, and from it flue-piping of heavy Russian iron should run round inside, with the outlets between the two furnaces. Ventilators are necessary at both the top and bottom of the building, and may be provided by two rabbit-hutch types on each of the four sides at the bottom, and two cupola ventilators at the top. Plans will be forwarded to any grower desiring to erect such a building on application to the Department of Agriculture.

As already stated, considerably experience is necessary to successfully flue-cure tobacco, and no definite rules can be laid down, as each type of leaf is a factor of importance, and each barn-full differs from its predecessors.

There are three stages in curing. They may be stated as follows:—(1) Yellowing, (2) fixing, (3) killing. No fixed formula can be given, but if the following is taken as a basis the grower will, after curing a few barns, be able to modify or vary the process in some respects to give him the desired results.

As soon as the barn is full close the building right up, start the fire going, and bring the temperature up to 90 degrees Fah. Keep it at this point for eighteen to thirty-six hours, according to the condition of the leaf, limiting the time to the shorter period in the case of leaf that is quite ripe, and allowing the full period where the leaf is not so well matured. If the leaf is not yellowing as it should, place sacks on the floor and soak them with water to produce a moist heat; or, better still, if a boiler is handy introduce steam. When the leaves have assumed a nice yellowish colour raise the temperature to 100 degrees, at the rate of 5 degrees each two hours, and keep at this figure for some six hours. Then raise the temperature to 105 degrees and give a little ventilation top and bottom, opening the ventilators a few inches. In these directions it is presumed that the curing-room is one that has been erected in accordance with proper plans, such as would be supplied

by the Department of Agriculture, as stated above. In such a building, both temperature and ventilation could be controlled so as to produce the results desired.

Having obtained the temperature of 105 degrees with the limited ventilation mentioned, the conditions should be maintained for three or four hours. Then increase the temperature to 110 degrees, and also increase the ventilation to about one-half of the capacity of the ventilators, and hold at that for three hours. Do not raise the temperature above 110 degrees until the tips of the leaves have dried, however. Next, again raise the temperature to 115 degrees for six hours, giving **full** ventilation, and then again advance to 120 degrees for two hours with full ventilation. The most critical time is between 110 degrees and 120 degrees. If the heat is too fast the leaf will splotch or blister, and if too slow it will sponge. When the sweat can be observed on the leaf, and it will not go off at once, the temperature must be increased rapidly by 10 degrees, and all available ventilation given; but if ventilation is given as directed there is little fear of sponging.

After remaining at 120 degrees for six hours, leave the ventilation at full, and increase the temperature by 5 degrees every two hours to 135 degrees; beyond this do not further increase the temperature until the blade of the leaf has dried out completely. Then exhaust all moisture by raising the temperature every hour by 5 degrees to 180 degrees, and gradually decrease the ventilation until only a very little is left at the top. Keep at the latter temperature until the stems and stalks have completely dried out. Ventilation plays a **most important part** in successful flue-curing during the stage from 105 to 140 degrees, and growers should pay particular attention to this matter. The whole process will take five or six days.

Extinguish the fire as soon as the tobacco is cured, and open the doors and ventilators to cool it off for twenty-four hours. If the weather be very dry, the moisture content of the barn may be increased with the aid of steam, or by means of water thrown on sacks on the barn floor. When the tobacco is in a condition to handle without the leaves breaking, it should be taken down on the sticks and bulked until the grower is ready to grade and bale for market as opportunity occurs.

Stripping.

So much time and labour have necessarily to be expended by growers before the tobacco leaf is ready for stripping and bulking, that the adoption of correct methods at this stage is a matter of enhanced importance. Yet there are those who quite fail to realise the extent to which the quality may be influenced in the processes of stripping and bulking, and who are consequently disappointed at the eventual refusal of buyers to take the leaf at all, or at the very low price offered. A few suggestions should, therefore, be helpful to growers.

As soon as the stem and stalk of the tobacco have dried, and the atmospheric conditions will permit, the leaves should be stripped from the stalk, and made into "hands." Each hand should consist of twelve leaves, and should be made by binding the stem-butts with a leaf tightly and neatly passed twice around them, and by opening the hand in the centre and pulling the end of the binder through.

When stripping from the stalks, opportunity should be taken to sort the leaves into three classes, No. 1 containing only leaves that are of good bright or yellow colour, and undamaged, No. 2 containing the leaves that are reddish-brown and undamaged, and No. 3 containing dark leaves, such as are damaged and would not fall within either of the other two classes.

While not necessary with flue-cured tobacco, in the case of leaf that has been air-dried the hands should be re-hung on the sticks, and given as much sun as possible for a few weeks on a scaffold close to the shed. Care should be taken not to put out more stocks at one time than can be removed to cover at the approach of rain. After each lot of sticks has been "sunned," they should be hung in the shed for a further period of about two months, after which the hands should be bulked down, each in its own class, for some six weeks at the beginning of the warm weather.

Bulking Down.

For bulking the hands, the leaf should not be moist, but in such condition that the tips can be squeezed together without breaking, and that a slight shaking will release one from the other. Opportunity should also be taken of straightening out the hands to improve their appearance before putting into bulk. Leaves with "fat stems" (stems not dried out) should not on any account be included in the bulk, or mould will very quickly appear.

"Bulks" are made by placing two rows of hands, overlapping by about one-third of their length, with the butts outward. The height should not be less than 4 feet. The length will be determined by the amount of leaf to be treated. The larger the bulk, the less it will be affected by outside climatic influences.

Growers are advised to cover each bulk as it is completed with blankets or tarpaulins, and to place weights on top, the object being to conserve the heat and moisture, and to avoid the drying out of the leaf. The prime cause of mould is the bulk becoming moistened and chilled, and every precaution should be taken against this. The bulk should be placed on boards well off the ground, so that air may circulate freely underneath.

Each bulk should be carefully examined every day, and if one is found to be too warm it should be broken down, and after each hand has been well shaken and lightly aired, should be rebuilt, those hands which were formerly in the centre being placed on the outside, the outside layers in the centre, and the lower layers on the top.

Leaf that has been through the bulking progress satisfactorily shows an absence of gumminess, and also the presence of crystals, which, though minute, can be seen when the leaf is held up to the light.

APPENDIX B.

Flue-curing Tobacco Barns.

(Reprint of Pamphlet issued by the Department of Agriculture, New South Wales.)

General.

For the type of barn shown on the accompanying drawings, either concrete or pise may be used for the walls, in conjunction with squared posts set up at the corners and in the centre of each wall.

These posts are roughly squared above ground level, the round butts sunk 3 feet into the ground and the tops secured with the top plate temporarily fixed till the completion of the concrete walls. After securing the posts with the plates and temporarily bracing with a diagonal batten at each corner, No. 8 fencing wire, or, preferably, barbed wire, is placed in the centre of each wall. This wire should be placed at 24-in. centres, run through the centre of each post, and strained taut.

The concrete or pise filling may now be proceeded with; and it is here that the posts make for rapid and easy construction of the walls, besides being a source of great strength to the building as a whole. The boxing to receive the concrete or pise filling is formed by planks or lining 1 in. thick, reaching from post to post, each side about 3 ft. wide, cleated at each end and at 24-in. centres with 3-in. x 1-in. hardwood cleats.

With these linings temporarily but securely fixed to both sides of the posts, the concrete or pise filling may be proceeded with, care being taken that the boxes for ventilators are first fixed in position. This filling must be well packed, and to bond it with the work that is to come on top of it, the top must be left rough. It must also be soaked with water before filling in the next lift.

Concrete.

The following tables gives the ingredients and proportion for making concrete:—

No. 1—Cement Concrete.

Parts—

Cement 1, sand 3, stone broken to 1½-in. gauge 7; or
Cement 1, sand 1, cinders 7; or
Cement 1, river shingle 7*; or
Cement 1, coarse river sand 5.

No. 2—Lime Cement.

Parts—

Lime 1, sand 2, stone broken to 1½-in. gauge 4; or
Lime 1, sand 1, cinders 4; or
Lime 1, river shingle 4; or
Lime 1, coarse river sand 3.

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* The river shingle should contain about 50 per cent. sand, while the largest pebbles should be about 1½ in. diameter.

No. 3—Lime and Cement Concrete.

Parts—

Cement ½, lime 1, sand 3, stone broken to 1½-in. gauge 6; or
Cement ½, lime 1, cinders 6; or
Cement ½, lime 1, river shingle 6; or
Cement ½, lime 1, coarse river sand 5.

Mixing.

The measuring of the ingredients for the concrete is an important part of the work, and requires careful attention.

For all classes of concrete the mixing should be done on a wood or similar platform, and the mixture placed in position in the walls and well packed immediately it is mixed. Cement concrete that has been allowed to stand and become partially set is no good, and should not be used.

The face of the walls should be worked over with a wood float or trowel to an even but not necessarily smooth face, as soon as the boards are removed and before the material sets too hard.

No. 1—Cement Concrete.

For cement concrete a gauge box 4 ft. 6 in. long by 2 ft. wide by 12 in. deep, which equals 9 cubic ft., is a useful size, and requires one bag of cement, containing 1-1/3 cubic ft.

The box is first filled with the aggregate and afterwards, by using a movable partition placed in the centre, will serve as a gauge for the sand. These quantities to one bag of cement are the usual for No. 1 concrete, similar to the 1-3-7 mixture given in the table.

The ingredients must be well mixed by turning them over twice in a dry state, and twice whilst being wetted from the rose of a watering-can or hose.

No. 2—Lime Concrete.

To make No. 2 concrete, the lime is mixed in a hot, creamy state, first with the sand and then with the aggregate.

No. 3—Lime and Cement Concrete.

For No. 3 concrete, first mix the sand and cement together in a wet state, then add the lime, and mix the whole together with the aggregate.

Pise.

Pipeclay loam containing ironstone gravel is the most satisfactory for this class of work. Material which is too sandy will fret away, and one containing too much clay will crack. Any vegetation growing on the surface of the earth selected should be removed, as also should any roots, bits of stick, &c. The earth is best used as it is dug, and if too dry should be brought to the correct moist condition by watering it about two days before it is to be used. No amount of tempering after it is dug will render it as suitable as watering in the solid as described. The earth should be just moist enough to be crumbly, and yet adhesive enough to retain the impression of the fingers when pressed into the hand. If too moist it will stick to the rammer and work up squashy; if too dry it will work up loose under the rammer.

After the earth has been dug it should be reinforced with straw or long grass worked into it. It is then placed in the boxing in layers about 6 in. deep, and rammed tight.

Before erecting the forms to receive the pise filling, fix 3-in. mesh 18 gauge galvanised wire netting to both sides of the posts, care being taken that the netting is kept hard up against the forms during the process of filling and tamping.

Furnaces.

With all four classes of material it is advisable to build the furnaces with bricks laid in cement mortar, gauged one part cement to two parts sand. The bricks before being laid should be well soaked with water, whilst the finished work requires protecting with bags or the like for at least twenty-four hours from heavy frosts or the drying effects of a hot day.

If desired, the furnaces may be built with cement concrete mixed in the proportion of one part cement, three parts sand, and six parts of a suitable aggregate broken to 1-in. gauge.

A good class of igneous (volcanic) rock, such as basalt, granite, quartz, &c., is recommended for aggregate. Sedimentary rocks, such as sandstone, limestone, &c., are not suitable for this particular class of work. Unless absolutely certain of the fire-resisting qualities of the material it is advisable to submit samples for approval before going on with the work. Make the crown of the furnace 9 in. thick, reinforced with 1½-in. mesh 16 gauge wire netting, placed right over the crown 2 in. from the top.

On completion the work must be covered with bags as stated for brick furnaces.

Flues.

On the accompanying drawings the flues are indicated to be trenches cut in the ground, lined on either side with 4-in. concrete walls, and the top covered in with corrugated iron flattened out and bearing on the concrete walls, 4 in. There is, however, another type of flue in use, consisting of 12-in. diameter pipes made from 24 gauge galvanised plain iron with riveted joints. These pipes or flues should be laid slightly raised above the ground and pitched towards the chimney. Square brick pits are recommended for the angles in lieu of galvanised-iron elbows. These will be required to be of 14 in. by 14 in. internal dimensions, and 4½-in. walls, with the iron flues built in. The top may be covered over with a concrete slab or a piece of sheet steel or iron.

Variations the Grower may Introduce.

The attached specification is for the construction of a double barn, as shown on the plan, with lime concrete walls, and it is to be noted that the terms of the specification may in some respects be departed from to suit the purposes of the grower; for instance, he may fix the internal framing for hanging the leaf differently by using round timber in place of sawn, and even allow the sides of the flue trenches to go unlined with concrete if the ground is stiff.

The underside of the roof timbers may be lined with bags to catch the drip off the roof iron in lieu of the rubberoid specified.

SPECIFICATION of work to be done and the materials to be used in the erection of Flue-curing Tobacco Barns, as shown on the accompanying Drawings.

Materials.

Bricks. To be of good shape and well burnt.

Sand. To be sharp, gritty, river sand, free from vegetable matter.

Cement. To be Portland cement of Colonial manufacture, bearing test stamp of P.W.D.

Lime. To be lump lime, and quite fresh.

Cement mortar. To be mixed in the proportions of one part cement to two of sand.

Lime concrete. To consist of one part lime, one part sand, and four of clean furnace cinders, or one part lime, two parts sand, and four of stone broken to $1\frac{1}{2}$-in. gauge. The whole to be mixed on a wood or similar platform, placed in the boxing, and packed whilst the lime is still hot.

Timber. Doors, shutters, &c., to be of Colonial pine. Drying racks and bearers of hardwood, and the balance either hardwood or Cypress pine. All to be cut to the full size stated.

Excavator. Clear the site of turf and all vegetable matter, and excavate to the depths indicated for flues, trenches, and furnaces. The trenches to be cut vertically, bottoms level, and the soil wheeled clear of the building.

Bricklayer. Build furnaces, bases of stacks, and the intervening walls with brick in cement mortar. Furnaces to be 2 ft. wide, 4 ft. 6 in. long to the bridge, and 2 ft. high from firebars to underside of the roof. The roof to be turned to a semicircle, with two $4\frac{1}{2}$-in. rings. The bridges to be 9 in. in old English bond, carried up to within 12 in. of the roof, and bonded to walls.

Floors of ashpits to be brick on edge, laid on a bed of sand 2 in. deep, and grouted up with liquid cement mortar. Top of floors to be 9 in. clear of firebars at the bridge, and 6 in. clear at the opposite end.

Provide furnaces with cast-iron firebars spaced $\frac{1}{2}$ in. apart and supported with $1\frac{1}{4}$-in. x $1\frac{1}{4}$-in. cross bars built into brickwork.

The brick casing to furnaces to be in old English bond, with bricks on edge for the top course. The whole to be grouted with liquid cement mortar.

Bases of stacks. To be $4\frac{1}{2}$-in. work, bonded to walls, and to have 14-in. x 14-in. flues. The tops to be weathered round iron stacks with cement mortar.

Note additional fire-box shown on drawings. Firebox in base of chimney stack to assist draught is shown on plan and elevation, the fittings being those usually provided for ordinary copper boilers.

Construct the intervening walls, also the projecting nibs at the corners, with 9-in. work in old English bond, and leave vent-holes near furnace walls 14 in. high and 12 in. wide. Top course to walls to be brick on edge and the whole grouted solid as before specified.

The partition to the centre flue of each barn to be brick on edge in cement mortar.

To be of lime concrete, 18 in. wide and 12 in. deep. Footings under walls

Construct walls with 9-in. x 9-in. squared posts set up at corners, intersections, and doorways, also midway between corners. Put 4-in. x 3-in. top plates let into tops of posts and 5-in. x 2-in. bottom plates on edge sunk flush on outer face 6 in. above top of furnaces. Walls.

Put 4-in. x 3-in. trimmers on flat to heads of doors. For ventilators fix wood boxes the full width of the walls constructed with 1-in. stuff.

Put 9-in. diameter half-long sills to doors housed into the posts.

At 2-ft. centres put barbed wire horizontally through posts in the centre of walls, and strain taut.

Fill in between posts to the full height of walls with lime concrete 9 in. thick, the filling to be done in layers not more than 2 ft. high, and to be well packed.

Partition wall to be carried up to the slope of the roof and 15 in. above it. Corner and door posts of shed attached to barns to be sunk 30 in. into the ground as indicated on drawings.

To be 20 in. wide and 12 in. deep, lined on each side with concrete walls 4 in. thick. Cover over the flues with 26 gauge galvanised corrugated iron, supported with 1-in. x ⅜-in. iron bearers placed 2 ft. apart on edge. Flues

Except where otherwise specified, to be constructed with hardwood, 4-in. x 2-in. rafters birdsmouthed over top plates and spiked to 8 in. x 1¼ in. pine ridge boards, projecting ends to be cut plumb and to a line. 4-in. x 3-in. tie beams (five to each barn), and 4-in. x 2-in. braces from rafters. Tie beams and braces to be secured to rafters and at crossing with ⅜-in. cup-head bolts. Fix over roof battens before iron is put on 3 ply ruberoid to catch drip off iron. Roof.

Rafters to shed to be 4-in. x 2-in. at 4-ft. centres birdsmouthed over 4-in. x 2-in. wall plates. The plate against barn wall to be on edge and securely spiked to posts. Projecting ends of rafters to be cut as before specified. Put 3-in. x 1½-in. pine battens to all roofs at approximate 30-in. centres for corrugated iron.

Construct the internal framework of each barn with 6-in. x 3-in. bearer on edge, notched into centre posts, and 4-in. x 2-in. wall plates at same level secured to posts with ½-in. coach screws. Internal framework.

Build up five lines of drying racks with 4-in. x 1½-in. horizontal rails at 24-in. centres let into and secured at centres and at each end to 4-in. x 2-in. uprights, the uprights to be secured to tie beams and to bottom plates and bearer with ⅜-in. cup-head bolts.

To be of Colonial pine, constructed with 7-in. x 1¼-in. ledges, and 4-in. x 1¼-in. braces, sheeted over with 4-in. x 1-in. T. G. and V. jointed lining. Doors.

Doors to shed to be 7 ft. x 4 ft, hung in two leaves with 14-in. jap. tee hinges, and fastened with 8-in. galvanised tower bolts to head and sill, and one 10-in. galvanised pad bolt. Other doors to be 6 ft. 8 in. x 2 ft. 8 in., hung with 14-in. jap. tee hinges and fastened with 10-in. galvanised hasp, staple, chain, and pin.

Vent shutters to be out of 6-in. x 1-in. T. and G. lining. To have 2-in. x 1-in. cleats and to slide on 2-in. x 1-in. guides, the latter to be secured at ends to 2-in. x 1-in. verticles. Ventilators.

Plumber.

Guttering. Provide and fix to eaves on strong galvanised-iron brackets 4½-in. quarter-round 24 gauge galvanised iron guttering with lapped, riveted, and soldered joints.

Roof iron. Cover roof with 26-gauge galvanised corrugated iron fixed to 3-in. x 1½-in. battens with 1¾-in. galvanised screens and lead washers. The sheets to be lapped 6 in. at ends and 1½ corrugations at sides. Finish with 2-in. rollover gable rafters; also turn up the iron against party wall to make a watertight finish.

Skylights. Provide and fix in roof of each barn four skylights (two on each side), filled with 26 gauge plain galvanised iron in lieu of glass. Each skylight to be hinged, and to be operated from ground outside barn walls with Sampsone No. 4 sash cord running over two 1¾ in. galvanised side awning pulleys fixed to rafters.

Provide and fix in roof of shed four similar skylights. Two to be fixed, and two to be hinged and operated with sash-cord and pulleys as specified for barns.

Fix to walls, one to each skylight, and approximately 5 ft. above ground, wrought-iron eye bolts to screw with 1½-in. diameter ring for hitching cords of skylights.

Ridging. Cover ridges with 16-in. 24-gauge galvanised ridging, and box in at gables.

Down pipes. To roof guttering fix three lines of 3-in. 24 gauge galvanised down pipes, with shoes to discharge on to the ground. To be secured to wall posts with suitable galvanised iron bands.

Chimney stack. Provide and fix 12-in. diameter 18 gauge iron chimneys, one to each barn, and fitted with square flange at 4 in. from bottom end. Each to be 12 ft. high, set up on brick base and secured to wall posts at the top with tie wires. The bases to be weathered off with cement mortar as specified under Bricklayer.

Rendering. Partition walls, where showing through the roof, to be rendered ⅝ in. thick with cement mortar and steel trowelled. To be mixed in the proportion of one part cement to two of sand.

Painting. Doors and woodwork of ventilators to be stopped and painted with two good coats of the best white lead and raw linseed oil paint.

PLATE 44.—NEW BANANA LAND.
The building is a packing shed; the background is typical Queensland scrub or jungle.

PLATE 45.—ON THE SAME PLANTATION.
The outlook from the packing shed.

PLATE 46.—A GROVE OF "LADY'S FINGER" BANANAS—TWELVE MONTHS FROM THE TIME OF PLANTING—MARY VALLEY.

PLATE 47.—QUEENSLAND BANANAS.

A "hand" of the Cavendish variety grown in the Mary Valley. The "hand" contains 21 fruit, averaging 10 inches in length measured round the curve, and 5 inches in circumference. Total weight 9 lb.

PLATE 48.—A MIDDLE YORKSHIRE STUDY.

Note the rugged outline and sturdy characteristics of this sire. It is interesting also to note the capacity of his mouth and the development of tusks.

THE DAIRY HERD, QUEENSLAND AGRICULTURAL COLLEGE, GATTON.

MILKING RECORDS FOR DECEMBER, 1923.

Name of Cow.	Breed.	Date of Calving.	Total Milk.	Test.	Commercial Butter.	Remarks.
			Lb.	%	Lb.	
Netherton Belle	Ayrshire	30 Oct., 1923	840	3·8	37·50	
College Cobalt ..	Jersey ..	14 Sept., 1923	780	4·0	36·30	
Fair Lassie ..	Ayrshire	28 Nov., 1923	759	3·8	33·99	
College Wildflower	Jersey ..	13 Aug., 1923	630	4·5	33·30	
College Grandeur	,,	11 July, 1923	540	4·9	31·20	
Dawn of Warragaburra	,,	10 Nov., 1923	630	4·0	30·60	
Magnet's Leda ..	,,	18 Aug., 1923	630	4·1	30·30	
College Cold Iron	,,	23 April, 1923	540	4·7	29·70	
Miss Fearless ..	Ayrshire	17 Nov., 1923	690	3·7	29·70	
Bellona	,,	3 Aug., 1923	630	4·0	29·40	
College Promise	Jersey ..	14 Aug., 1923	540	4·6	29·10	
Hedges Madge ..	Friesian	18 Aug., 1923	750	3·2	27·90	
Miss Security ..	Ayrshire	8 June, 1923	660	3·6	27·60	
Dear Lassie ..	,, ..	1 Nov., 1923	600	3·9	27·30	
Buttercup ..	Shorthorn	7 Sept., 1923	780	3·0	27·00	
Comedienne ..	Jersey ..	10 July, 1923	480	4·8	27·00	
Miss Betty ..	,,	30 Oct., 1923	600	3·8	26·70	
Lady Loch II. ..	Ayrshire	26 April, 1923	540	4·2	26·70	
Snowflake ..	Shorthorn	17 May, 1923	540	4·1	25·80	
Lady Meg ..	Ayrshire	14 July, 1923	570	3·8	25·50	
Yarraview Snowdrop	Guernsey	7 Sept., 1923	510	4·3	25·50	
Songstress ..	Ayrshire	22 Aug., 1923	510	4·2	25·20	
Lute	,,	26 April, 1923	540	3·8	24·00	
Confidante ..	,,	7 Sept., 1923	570	3·5	23·10	
College Hope ..	Jersey ..	21 Oct., 1923	480	4·1	23·10	
Gay Lassie ..	Ayrshire	5 July, 1923	450	4·3	22·50	
College St. Martha	Jersey ..	25 June, 1923	390	4·8	21·90	
College Desire ..	Ayrshire	11 July, 1923	480	4·0	22·20	
College La Cigale	Jersey ..	25 June, 1923	360	5·0	21·00	
Hedges Mattie ..	Friesian	21 Nov., 1923	600	3·0	20·70	
College Ma Petite	Jersey ..	12 June, 1923	480	3·6	20·19	
Mistress May ..	Ayrshire	20 June, 1923	480	3·6	20·19	
Lady Amy ..	,,	7 July, 1923	390	4·4	20·10	

WINTER GREENFEEDS.

EXPERIMENTS ON THE TABLELANDS.

The Northern Instructor in Agriculture, Mr. N. A. R. Pollock, forwards the following notes on Winter Greenfeeds on the Tableland:—

During the past four years the Department of Agriculture has conducted trials of various crops to provide a succulent and balanced feed for dairy cattle during the winter and later months, when pasturage is scanty or in short supply.

Attention has been drawn to the success of these crops previously in the Press, but it may not be out of place to republish the results obtained on the farm of Mr. R. Campbell, at Peeramon, in 1921, which in seasons of usual rainfall should be generally obtainable.

New scrub land under pasture for several years; ploughed early in April, after a crop of maize had been taken off for ensilage; seed sown 22nd April, yields estimated 3rd August; area, 3 acres.

Plot 1.—Blue field peas: Yield of green stuff (pods well set), 8 tons per acre.

Plot 2.—Grey field peas: Yield of green stuff, 15 tons per acre.

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Plot 3.—Golden Vetches: Yield of green stuff, 8 tons per acre.

Plot 4.—Golden Vetches and Bunge Wheat: Yield of green stuff, $14\frac{1}{2}$ tons per acre.

Plot 5.—Bunge Wheat: Yield of green stuff, 8 tons per acre.

Plot 6.—Amby Wheat: Yield of green stuff, $6\frac{1}{2}$ tons per acre.

Plot 7.—Warren Wheat: Yield of green stuff, $9\frac{1}{2}$ tons per acre.

Plot 8.—Florence Wheat: Yield of green stuff, $5\frac{1}{2}$ tons per acre.

The time of harvest was opportune for the wheat varieties Bunge and Warren to weigh well; the latter especially was at its heaviest stage, just breaking into ear, whereas Florence was almost ripening off.

As a result of these, as well as of the experiments of other years, the following crops are recommended for sowings to provide green feeds for the winter and subsequent lean months.

Florence Wheat.

A good early dual purpose variety, especially suited to dry conditions; foliage, sparse to medium; stooling poor to fair; season, very early.

This wheat first introduced to the Tableland by the Department is now generally favoured, as it has been proved the surest cropper, more especially in the drier maize areas. Sowings should be made at the rate of $1\frac{1}{2}$ bushels to the acre, owing to its poor stooling properties. If sown, combined with a legume, one bushel is sufficient with half a bushel of the latter. Two or three sowings could be made at intervals of three or four weeks between to provide continuity.

NOTE.—In speaking of a variety being early, mid-season, or late, the meaning is that the crop is of short, medium, or long period in reaching maturity. Where wheats are grown for grain, the late varieties are planted much sooner than the early varieties.

Warren Wheat.

A good dual purpose wheat; useful in dry country; straw, nearly solid; foliage, medium abundant; stooling, very good; season, mid-season.

This wheat is not such a sure cropper as Florence in a dry time, but under ordinary seasonal conditions in the dairy areas should be very profitable. If fed off when seven or eight weeks old, and then left for a final yield, much satisfaction should be obtained. Sow one bushel and a-quarter to the acre, or if combined with a legume, one bushel.

Bunge Wheat.

This is an early wheat, but requires for its success more rain than Warren or Florence, and also likes a heavier soil.

Golden Vetches.

This legume has done remarkably well in all trials, and should be grown in all winter feed crops. In the young state, matured, or as hay, it is relished by stock, and it is especially valuable when combined with a cereal, while the latter helps to support it. When grown alone, sow 30 lb. to 50 lb. per acre, and when sown with a cereal, 20 to 30 lb. with a bushel of the cereal.

Field Peas.

The grey field pea has given higher yields of green feed than the blue variety, but possibly the yield of seed or peas might be heavier in the blue—a factor to be considered if pigs are to be fed. Both varieties should be tried for comparison.

Sowings alone should be at the rate of 40 to 60 lb. per acre, and if combined with wheat, 20 to 30 lb.

Oats are not recommended on the Tableland, owing to their susceptibility to rust.

Skinless barley has been found to give fair yields, but not as good as those from wheat.

The wheat varieties (Florence, Warren, and Bunge) are all good rust-resisters, and in all trials have shown very little or no rust on the flag, when oats were badly affected.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF JANUARY, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALLS DURING JANUARY, 1924 AND 1923, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Jan.	No. of Years' Records.	Jan., 1924.	Jan., 1923.
North Coast.	In.		In.	In.
Atherton	12·02	22	5·76	6·99
Cairns	16·68	41	7·90	3·81
Cardwell	16·95	51	4·60	4·31
Cooktown	15·01	47	6·43	7·46
Herberton	9·66	36	6·38	5·35
Ingham	16·30	31	7·35	6·46
Innisfail	20·60	42	8·97	11·37
Mossman	17·70	15	4·85	7·61
Townsville	11·66	52	1·55	1·14
Central Coast.				
Ayr	12·09	36	1·93	0·32
Bowen	10·37	52	0·65	0·91
Charters Towers ..	5·77	41	0·30	6·28
Mackay	15·13	52	1·35	8·65
Proserpine	17·47	20	3·93	4·26
St. Lawrence ...	10·04	52	2·12	6·22
South Coast.				
Biggenden	5·40	24	2·05	5·59
Bundaberg	9·17	40	1·48	8·22
Brisbane	6·32	73	2·27	2·79
Childers	7·88	28	2·81	4·44
Crohamhurst ...	12·56	30	7·13	4·56
Esk	5·54	36	3·92	1·95
Gayndah	4·77	52	0·46	3·71
Gympie	6·73	53	2·07	5·70
Glasshouse Mts. ...	8·82	15	7·70	3·30
Kilkivan	5·68	44	1·38	2·64
Maryborough ...	7·42	52	2·44	5·26
South Coast—continued:	In.		In.	In.
Nambour	9·27	27	5·06	5·99
Nanango	4·52	41	4·45	3·38
Rockhampton ...	7·96	52	1·22	5·49
Woodford	7·36	36	5·03	4·31
Darling Downs.				
Dalby	3·32	53	2·64	3·37
Emu Vale	3·06	27	5·15	3·15
Jimbour	3·71	35	2·08	1·18
Miles	3·85	38	2·85	2·48
Stanthorpe ...	3·50	50	6·91	2·80
Toowoomba ...	4·90	51	4·77	3·02
Warwick	3·47	58	6·40	3·29
Maranoa.				
Roma	3·40	49	2·51	2·28
State Farms, &c.				
Bungeworgorai ...	2·22	9	2·61	2·33
Gatton College ...	4·20	24	2·38	2·39
Gindie	4·00	24	0·14	1·85
Hermitage ...	2·81	17	5·86	3·28
Kairi	7·79	9	3·75	4·65
Sugar Experiment Station, Mackay	16·46	26	1·82	5·95
Warren	6·40	9	1·38	3·59

NOTE.—The averages have been compiled from official data during the periods indicated; but the totals for January, 1924, and for the same period of 1923, having been compiled from telegraphic reports, are subject to revision.

GEORGE G. BOND,
State Meteorologist.

STAFF CHANGES AND APPOINTMENTS.

S. C. Todd, Inspector under the Diseases in Plants Act at Wallangarra, has been appointed an Inspector of Stock, as from the 7th March, 1924.

S. L. Brimblecombe has been appointed an Honorary Inspector under "*The Diseases in Plants Act of* 1916."

W. T. Harris, H. Nuss, and C. E. Smith, all of Toowoomba, have been appointed Honorary Inspectors under and for the purposes of "*The Diseases in Plants Act of* 1916."

J. R. D. Munro, Warwick; A. B. Smyrell, Roma; and H. J. D. McBean, Ravensbourne, have been appointed Inspectors of Poultry under "*The Diseases in Poultry Act of* 1923."

Jack Davies, Roma, has been appointed an Honorary Inspector of Stock.

The resignation of H. M. Stevens of his position as Chairman of the Egg Pool Board has been approved, and H. H. Bentley has been appointed in his stead.

The appointment of E. J. Shelton, as Instructor in Pig Raising, has been confirmed as from the 17th August, 1923.

WEEDS OF QUEENSLAND.

BY C. T. WHITE, Government Botanist.

No. 35.

BITTER BARK, NATIVE CINCHONA OR QUININE (*Alstonia constricta*).

Description.—A small tree, often flowering and fruiting as a shrub, suckering freely from the roots. Bark very bitter, thick and corky on the larger trees. Leaves opposite, lanceolate, 3 to 5 in. long on slender stalks of ½ to 1 in. Flowers small yellow or yellowish green, arranged in terminal cymes. Seed vessels (follicles) in pairs, narrow, round, elongate, 5 in. to about 1 ft. long, splitting open along one side when ripe; seeds numerous, about ½ in. long, covered with long brownish hairs.

Distribution.—A native of Queensland and New South Wales; in Queensland it is very abundant in the drier scrub areas such as occur in the Burnett District, Northern Darling Downs, &c.

Common Name.—The names Bitter Bark, Native Cinchona, and Native Quinine are all in general use. They are also applied to a totally different plant—*Petalostigma quadriloculare,* a small tree with rounded leaves and round yellow fruits.

Botanical Name.—*Alstonia,* in honour of Dr. Charles Alston, Professor of Medicine and Botany in the University of Edinburgh, 1740-1761. *Constricta* (Latin) meaning constricted; the top of the corolla tube of the flower is somewhat constricted.

Troublesome Character.—Many complaints have reached me regarding the growth of this plant in cultivation areas owing to the habit the roots possess of throwing up strong sucker shoots, particularly when disturbed as is done by ploughing.

Economic Uses.—The bark is a valuable tonic, and both it and the bark of *A. scholaris* (a North Queensland and Asiatic species) are official in the British Pharmacopæa. A decoction of the bark has been used as a tick-wash. It has also been used by brewers to add a bitter flavour to beer.

Eradication.—Eradication is probably best carried out by poisoning the plants with an arsenical solution. Standing trees may be "frilled" by making a succession of downward axe cuts right round the tree into the sapwood, each cut overlapping the other so as to leave no unsevered bark or sapwood for the conveyance of food-containing sap for the tree. The solution should now be freely poured into the frill with a watering-can (without a rose) or old teapot or keetle.

Bitter bark suckers freely, and the eradication of sucker growths in paddocks or cultivation areas is more difficult; the suckers might be cut down, however, and a solution painted over the cut stump with a brush or swab. They, also, of course, can be grubbed out, and constant grubbing will exhaust the old roots eventually; an arsenical solution poured round the grubbed plant would no doubt be effective but would poison the ground for some time for all other plants.

A suitable solution is—Arsenic 1 lb., caustic soda 2 lb. or washing soda 3 lb., water 4 gallons. The soda is necessary to help the arsenic dissolve, and Mr. G. B. Burrowes, Assistant Inspector of Agriculture in New South Wales, writing in the "Agricultural Gazette" of New South Wales, recommends the addition of whiting, because the whiting dries white and shows which trees or plants have already been treated. If ordinary washing soda is used, boiling will be found necessary to bring about complete solubility; but, if caustic soda, the heat generated does away with the necessity of boiling.

Botany.—There are two distinct forms of this species in Queensland, the first with the leaves glabrous and smooth on both surfaces, the latter with the young shoots and the under surface of the leaves densely clothed with soft hairs (var. *mollis*), a third variety (var. *montmariensis*) has been described from the Maranoa district, but this is probably only a small leaved form of var. *mollis.*

Reference.—*Alstonia constricta,* F. Mueller, "Fragmenta Phytographiæ Australiæ," 1, 50 (1858).

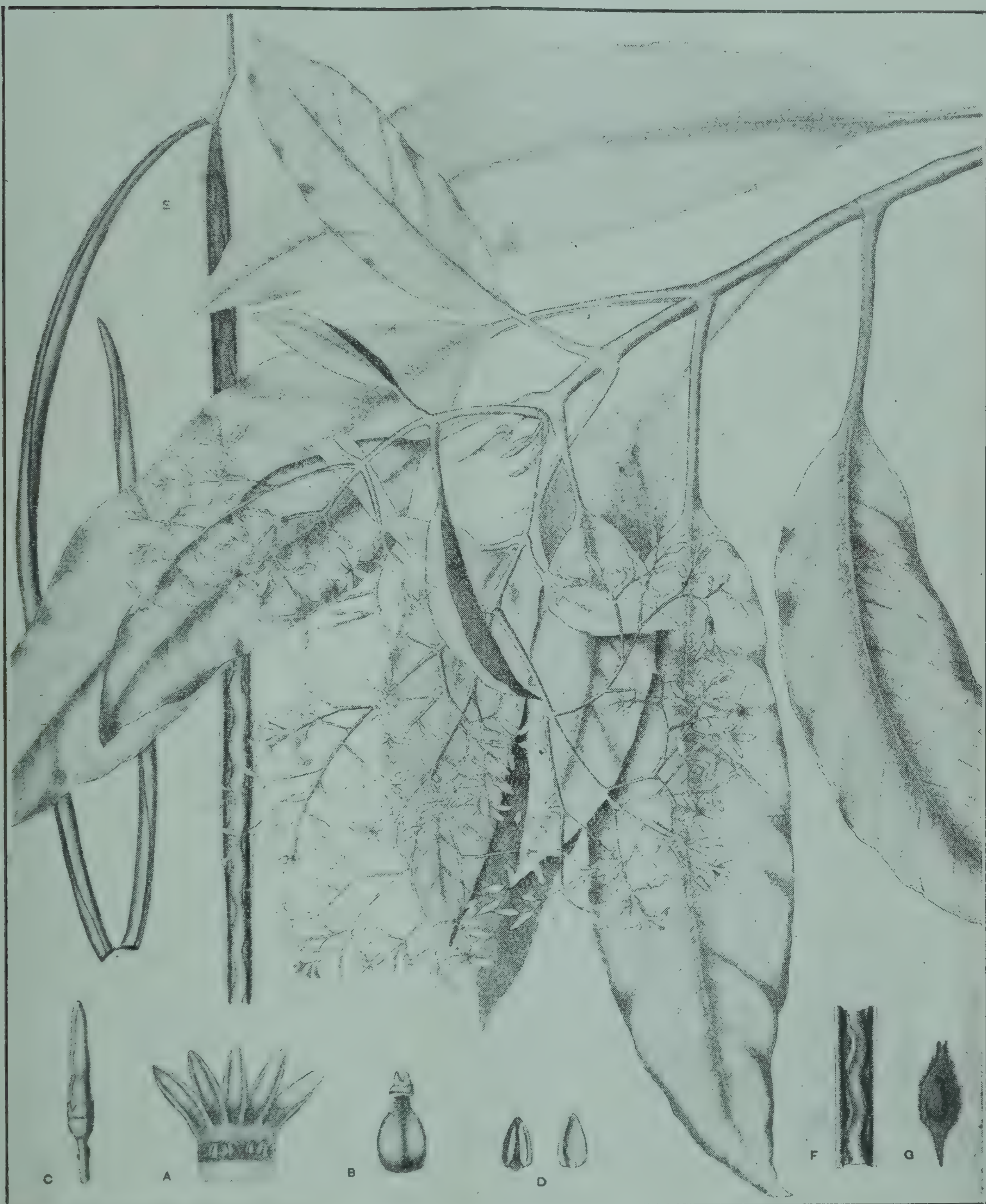

PLATE 49.—BITTER BARK, OR NATIVE CINCHONA (*Alstonia constricta*).

A.—Corollo laid open. B.—Ovary. C.—Flower fluid. D.—Anthers.
E.—Seed pod (follicle). F.—Portion of seed pod enlarged. G.—A seed.

(After Maiden, in "Forest Flora of New South Wales.")

General Notes.

The Primary Products Pools Acts—Regulations.

License Regulations under *"The Primary Products Pools Acts,* 1922 *to* 1923," have been issued in relation to wholesale dealers in cheese, and are to take effect as from the date of publication in the "Government Gazette," viz., 8th March. These Regulations provide that every wholesale dealer who desires to trade in cheese shall, before commencing to trade in such commodity, make application to the board for a license to so trade, while every wholesale dealer who is trading in cheese at the date of these Regulations taking effect must make application for a license within thirty days after such date. The board, with the approval of the Minister for Agriculture and Stock, is given the power to grant, or refuse to grant, a license to any applicant, or, having granted, may suspend or cancel any license. Such refusal may be made without any reason being assigned therefor. Every license will be in force from the date it is granted until the 30th June following, unless it is cancelled or suspended, and will not be transferable. The license will be issued free, no charge being made. Any person who commits a breach of these Regulations is liable to a penalty not exceeding £100.

"Bunchy Top" in Bananas—Its Queensland History.

The Acting Premier and Minister for Agriculture (Hon. W. N. Gillies) stated in the course of a recent Press interview that the actual time of the discovery of "Bunchy Top" in New South Wales is not actually known in Queensland, but from general knowledge the first appearance in that State may be set down as from 1910 to 1912. Its occurrence in Queensland was first noted in 1916 by Mr. Benson, the Director of Fruit Culture, who observed it among some banana plants that had been brought from over the border in the previous year. The disease was not, however, treated seriously until 1919, when investigations were made upon a farm at Currumbin. In 1920, as a result of these investigations, an experimental plot, covering two acres, was established at that place, but within twelve months the whole of the plants within the area had become affected. The Government Entomologist also visited the infected area in this State, but no result has been secured from his inquiries. Similar negative results have been experienced by the growers of New South Wales who co-operatively offered a reward of £5,000 for diagnosis and remedy, apart from the investigations being made by Dr. Darnell-Smith, of the Department of Agriculture in New South Wales. Early in June of last year Mr. Green, M.H.R., proposed in the House of Representatives that the Commonwealth should offer a reward for a discovery of a cure, but the Federal Government, after consideration, preferred another course, to which reference is made later. Mr. Gillies at that time expressed the opinion that there would be far greater likelihood of attaining definite results from scientific effort in which competently trained and experienced investigators, prompted, as scientific men are, by other than material considerations, would be engaged. An arrangement was then made with the New South Wales Government whereby Dr. Darnell-Smith, the Plant Pathologist of that State, and Mr. Henry Tryon, Queensland Government Entomologist, would be associated in investigation with the help of other scientific men, like, for instance, Mr. Brünnich, the Agricultural Chemist, who has made exhaustive analyses of soils from areas carrying infected plants. Before, however, any definite action was taken in the matter, the two scientists met to discuss plans for investigation, and after visiting the Tweed area in company they decided to consider the infected area as one whole. Meanwhile, the consideration given by the Federal Government to the proposal made by Mr. Green, M.H.R., had produced another proposal from the Director of the Bureau of Science and Industry, that the Commonwealth, New South Wales, and Queensland should each contribute £1,500 for a further investigation. This was agreed to, and a committee has now been appointed. The members of the committee are Professor Goddard, B.A., D.Sc., Professor of Biology of the Queensland University, Professor Watt, M.A., B.Sc., Professor of Agriculture in the University of Sydney, and Professor Osborn, of the University of Adelaide. This committee has already entered upon its investigations.

Mr. Gillies added further that "Bunchy Top" has caused banana-growers in Queensland and himself considerable alarm owing to the insidious way in which it has advanced, and that it is now imperative that the investigations should be pressed to a degree that some check, if not a remedy, may be found for a plant disease that has hitherto baffled scientific men.

State Cheese Board.

In pursuance of the provisions of "*The Primary Products Pools Acts,* 1922 *to* 1923," and upon the recommendation of the Council of Agriculture, Wm. Purcell, H. H. Collins, and M. Lynch have been appointed Chairmen of the State Cheese Board, Atherton Tableland Maize Board, and Atherton Tableland Pig Board, respectively.

Leichhardt South Dingo Board.

The following amendments have been made to the by-laws of the Leichhardt South Dingo Board published in the *Government Gazette* of the 8th July, 1922:—

Section 2 of By-law No. 2: The word "seven" has been inserted in lieu of the word "twenty-one."

Section 3 of By-law No. 2: The word "four" has been inserted in lieu of the word "three."

The Government Clydesdale Sires.

The Minister for Agriculture and Stock (Hon. W. N. Gillies) has announced that the stallions purchased last year by the Government for the purpose of improving the breed of draught horses in Queensland have completed the season, and are now at the Queensland Agricultural College farm, where, by an arrangement with the Department of Public Instruction, they will remain until the spring. It will be remembered that these horses were bought about July last, and there was not much time for them to become accustomed to Queensland conditions before the season started. The number of mares allotted was consequently limited. The prolonged dry spell that followed was, of course, a factor against the securing of the best results, as stock generally was lower in condition than would be the case during a normal season. Notwithstanding these handicaps the season was fairly successful. In the course of the season 335 mares, an average of 56 each horse, were mated without mishap.

Co-operative Associations Act—Additional Regulations.

Additional regulations under the Primary Producers' Co-operative Associations Act have been issued, and are now in force. They provide, in accordance with the Act, for the registration of associations or federation. Forms of application will, in due course, be sent by the registrar of Primary Producers' Co-operative Associations to the various associations who have already applied for registration under the Act, and to others who in the future apply for registration. The regulations also deal with the registration of secretaries, treasurers, and directors of associations; the registration of amendments of rules of associations from time to time; the licensing of auditors; the cancellation of registration of associations or licenses of auditors when deemed necessary for the exemption, withdrawal, or dissolution of associations; exempting associations or companies from the operations of the Act by the Governor in Council on the recommendation of the Council of Agriculture, and the scale of fees.

Each of the following co-operative trading societies registered under the Industrial and Provident Societies Act, with the word "co-operative" as part of its registered name shall, until further notice, be allowed to continue to use the word "co-operative" as part of its name as so registered:—West Moreton Co-operative Society, Limited; Caboolture and District Co-operative Cash Stores, Limited; Maroochy Co-operative Society, Limited; Burnett Farmers' Co-operative Trading Society, Limited; Kenilworth Farmers' Co-operative Society, Limited; Fassifern Farmers' Co-operative Cash Trading Society, Limited; Toogoolawah District Co-operative Society, Limited; Twin View Co-operative Society, Limited; and Mapleton Co-operative Trading Society, Limited.

Every association shall keep a register of mortgages and a register of shareholders or members. A copy of the rules or articles of association of any association shall be supplied to any member upon application by him at a charge, including postage, not exceeding 2s. 6d.

A general meeting of the association shall be held within at least six months from the first registration of the association. Subsequent general meetings shall be held at least once within every twelve months.

Every association and every officer or member thereof committing a breach of any of these regulations shall, for every such breach, be liable to a penalty (where same is not provided for in the Act) not exceeding £20. The full text of the Regulations, schedules, and forms have been gazetted.

The War Against the Fruit Fly.

Regulation 57 under "*The Diseases in Plants Act of* 1916" has been rescinded, and Regulation 59 has been issued in lieu thereof. This Regulation provides that for the period commencing 1st April, 1924, and ending 31st March, 1925, the introduction of certain fruits into the Stanthorpe district, from any district within which the common Queensland fruit fly, or the Mediterranean fruit fly, or the spotted fruit fly, are known to exist is prohibited, unless such fruit has been in cold storage for a period of not less than twenty-one days at a temperature of not more than 35 degrees Fahr.

Sugar Research Scholarships.

Travelling Research Scholarships in connection with the sugar industry have been awarded as under:—

Arthur Frank Bell, Assistant to Analyst, Agricultural Chemical Laboratory, Department of Agriculture and Stock, to be Plant Pathology Scholar.

Henry William Kerr, Assistant to Analyst, Agricultural Chemical Laboratory, Department of Agriculture and Stock, to be Soils Scholar.

Norman Bennett, Assistant Sugar Chemist, South Johnstone Central Sugar Mill, to be Technology Scholar.

The scholarships will be tenable for a period of four years, and in the course of that period the holders will travel in various parts of the world for the purpose of studying every phase of the industry.

Khaki Weed and Blue Top.

The Government Botanist, Mr. C. T. White, F.L.S., replying to a request for information, writes:—

Many persons are much alarmed at the spread of these two pests on the Downs and some other parts of Queensland.

The khaki weed (*Alternanthera achyrantha*) is a native of South America, and was introduced into South Africa in the fodder from the Argentine during the time of the Boer war, and from South Africa it is thought to have made its way into Australia. Since its introduction to Australia it has steadily increased until it has become one of our worst weed pests. In 1918, an officer of the Department of Agriculture and Stock, Mr. F. B. Smith, B.Sc., Assistant Agricultural Chemist, visited Beaudesert to inquire into the destruction of khaki weed by chemical means, and reported that, "The weed was easily destroyed by common salt (butchers' salt or any coarse common waste salt) at the rate of 1-2 tons per acre. A weak arsenical solution containing 2 per cent. arsenic will also be found effective where this poisonous spray could be used."

The value of salt as a weed destroyer lies in its property of absorbing moisture both from the soil and plant tissues, and so kills the plant by thirst. Thus, to prove effective, it should be applied in hot, dry weather.

In small areas khaki weed is best destroyed by hand-grubbing or chipping, but as it has the power of sending out roots from the joints there is always a chance, unless the work is carried out in hot, dry weather, of the cut pieces growing again, so that the cut up plants should be all raked up and burnt.

Blue Top has been identified as *Heliotropium anchusæfolium*, a South American species of heliotrope that has been naturalised in Queensland for some years past. The species was no doubt introduced as a garden plant, and has been naturalised on the coastal lands for many years past, but has never given evidence there of being of an aggressive nature. A few years ago it made its appearance about Warwick, and has established itself as a very bad weed, most difficult to eradicate. The plant is a perennial, and makes a long, strong, slender tap root. In small areas such as gardens and household allotments, forking or pulling out the plant so that the central root is destroyed is the best means of eradication. In larger areas the plants should be hoed off, care being taken to see that the central root is cut off well below the surface of the ground.

Where it can be used in safety an arsenical spray might be tried, and as a spray suitable for weed destruction the Agricultural Chemist (Mr. J. C. Brünnich) has recommended the following:—"Half a pound of arsenic dissolved by means of one-quarter of a pound of caustic soda in 3 gallons of water, and the solution then diluted to 10 gallons with water." As the plant is of comparatively recent introduction on the Downs, and it already shows the power of becoming a bad pest, a lookout should be kept for it and the plants destroyed where they put in an appearance. It can be easily recognised by its blue flowers and typical heliotropey appearance.

Weights of Pigs at Weaning Time.

Several inquiries have recently been made on this subject, and it is an important one worth careful investigation. It is, however, difficult to quote figures regarding estimated weights of pigs at weaning time when the age at which the pigs were weaned is not clearly stated. The common practice in Queensland is to wean the pigs at seven to eight weeks old, but in the case of most of the figures that have been published on this subject, the weaning age is stated as from nine to ten weeks or even more. Then, again, there is little or no information available here covering results of experiment work or in keeping records such as these. My experience is that if pigs in any breed can be forced along so that they will weigh round about 35 lb. at weaning time (*i.e.*, eight weeks) then the breeder cannot complain. There are instances on record here in which pigs have weighed up to 45 lb. at this age.

Henry and Morrison, in their new "Feeds and Feeding" (an American publication), record various experiments that have been carried out on these lines, and a general average of the weights at weaning time (in this case at eight to ten weeks of age) runs about 38 lb., the weights varying from about 22 lb. in the case of the younger and lighter pigs, to 57 lb. in the case of the very best of the pigs.

In Australia we do not appear to be able to secure the very heavy weights in pigs recorded abroad, and in the case of the Large Black Pig Records in England the weights appear to be excessive. Yet under Australian conditions the Large Black made no headway, and after a few years' popularity they failed to "fill the bill" and have now gone out of favour altogether.

It would appear that if pigs are properly managed and given the right class of food, they should, after reaching the age of about eight weeks, begin to increase in weight at the rate of 1 lb. per day, so that at the age of six months (or roughly 120 days after weaning) they should weigh 120 lb., plus the weight at weaning time, which would ordinarily be about 35 lb., or a total weight at six months' old of around 155 lb. live weight.—E. J. SHELTON, H.D.A., Instructor in Pig Raising.

Forthcoming Shows.

The Queensland Chamber of Agricultural Societies has supplied the following list of show dates for 1924:—

Killarney: 19th and 20th March.
Toowoomba: 25th to 27th March.
Royal National Fat Steer Show: 29th March.
Dalby: 2nd and 3rd April.
Chinchilla: 8th and 9th April.
Nanango: 3rd and 4th April.
South Brisbane: 5th April.
Allora: 9th and 10th April.
Wallumbilla: 15th and 16th April.
Clifton: 16th and 17th April.
Herberton, 21st and 22nd April.
Oakey: 24th April.
Maleny: 23rd and 24th April.
Goondiwindi: 29th and 30th April.
Taroom: 6th and 7th May.
Blackall: 6th and 7th May.
Toogoolawah: 7th and 8th May.
Wondai: 8th and 9th May.
Boonah: 14th and 15th May.
Springsure: 14th and 15th May.
Murgon: 15th and 16th May.
Kilkivan: 21st and 22nd May.
Ipswich: 21st to 23rd May.
Emerald: 21st and 22nd May.
Beaudesert: 28th and 29th May.
Marburg: 2nd and 3rd June.
Esk: 4th and 5th June.
Maryborough: 3rd to 6th June.
Childers: 10th and 11th June.
Bundaberg: 12th to 14th June.
Pine Rivers: 13th and 14th June.
Lowood: 20th and 21st June.
Rockhampton: 24th, 26th, 27th, and 28th June.
Mackay: 3rd to 5th July.
Kilcoy: 3rd and 4th July.
Biggenden: 3rd and 4th July.
Bowen: 9th and 10th July.
Caboolture: 17th and 18th July.
Sunnybank: 19th July.
Barcaldine: 22nd and 23rd July.
Rosewood: 23rd and 24th July.
Ithaca: 25th and 26th July.
Nambour: 30th and 31st July.
Mount Gravatt: 2nd August.
Humpybong: 7th August.
Royal National: 11th to 16th August.
Gympie: 20th and 21st August.
Belmont: 23rd August.
Imbil: 27th and 28th August.
Crow's Nest: 4th September.
Wynnum: 6th September.
Beenleigh: 11th and 12th September.
Zillmere: 13th September.
Stephens: 20th September.
Rocklea: 27th September.
Southport: 10th October.

Farm and Garden Notes for April.

FIELD.—Those areas already lying in fallow for subsequent sowing with wheat should be kept in good tilth, using field implements that have a stirring effect in preference to those which tend to reverse the surface soil. The surface should never be allowed to cake; consequently all showers must be followed by cultivation, as soon as conditions will permit of teams and implements working freely.

Early fodder crops, such as barley (skinless or Cape) and certain varieties of wheat may be sown during April:—Growers of winter fodders will be well advised to study the article dealing with dairy fodder plots which appeared in February, 1922, Journal.

In those areas where seasonable rainfall permitted the planting of potatoes, these should now be showing good growth and must be kept free from all weed growths by means of the scuffler. If sufficiently advanced, and any doubt exists as to the prevalence of blight, advantage should be taken of fine weather to give a second spraying of "burgundy mixture," a calm and somewhat cloudy day being chosen if possible for the spraying.

Where land has been previously well prepared, lucerne sowing should be carried out this month, and intending growers of this fodder will be well advised to ascertain the germinating qualities of seed submitted to them for purchase. The difference between a good and bad "strike" is often traceable to the poor class of seed sown.

Maize and cotton crops should now be in the harvesting stage, and, once matured, are better in the barn than the open paddock, where weevils and other insects are usually prevalent at this season of the year.

Root crops sown last month should now be making fair growth, and during the early period of such should be kept free from weeds, and, where necessary, thinned out. Sowings of mangels, swedes, field carrots, sugar-beet, and rape may still be made where conditions of moisture will permit.

As the sowing season is close at hand for certain varieties of wheat—*i.e.*, those which require a fairly long period to develop in, every effort should be made to bring the seedbed into the best possible tilth and to free it from foreign growths of all kinds. The grading of all seed-wheat is strongly recommended, and growers who favour certain varieties should adopt a system of seed selection from prolific strains with a view to the raising of larger quantities of pure typical grain for ultimately sowing in their larger fields.

Pickling of wheat to prevent smut (bunt) is necessary. Germination tests should be carried out prior to commencing seeding operations.

Sorghums which have matured and are not immediately required as green fodder should, wherever possible, be conserved as ensilage to provide for a reserve, to tide over the period when grasses and herbage are dry. Succulent fodder of this description is the best possible form of insurance against drought, and for maintaining dairy and other stock in thrifty condition.

KITCHEN GARDEN.—Hoe continually among the crops to keep them clean, and have beds well dug and manured, as recommended last month, for transplanting the various vegetables now coming on. Thin out all crops which are overcrowded. Divide and plant out pot-herbs, giving a little water if required till established. Sow broad beans, peas, onions, radish, mustard and cress, and all vegetable seeds generally, except cucumbers, marrows, and pumpkins. In connection with these crops, growers are recommended to adopt some form of seed selection for the purpose of improving the quality of vegetables grown by them. Just at present, selections should be made from all members of the cucurbitaceæ (pumpkins, cucumbers, &c.). Tomatoes should also be selected for seed. Early celery should be earthed up in dry weather, taking care that no soil gets between the leaves. Transplant cauliflowers and cabbages, and keep on hand a supply of tobacco waste, preferably in the form of powder. A ring of this round the plants will effectually keep off slugs.

Orchard Notes for April.

THE COASTAL DISTRICTS.

In the orchard notes for March the attention of citrus growers was called to the necessity of their taking the greatest possible care in the gathering, handling, sweating, grading, and packing of the coming crop of fruit, as the returns for the labour expended in the upkeep of their orchards will depend entirely on the condition in which the fruit reaches the market. Many growers fail to realise the very important fact that the success of fruitgrowing does not depend merely on the proper working and management of the orchard, so essential for the production of a good crop of high-class fruit, but that the manner in which the fruit is handled and placed on the market is of even greater importance. In no branch of fruit culture is this more evident than in the case of citrus fruits, as no fruit pays better for the extra care and attention necessary to enable it to be marketed in the best possible condition. Every season there is more or less loss in the consignments sent to the Southern markets, the percentage depending mainly on the weather conditions, the loss in a wet year being much heavier than that in a dry year.

A very large percentage of the loss is due to what is known in the trade as specking—viz., a rotting of the fruit caused by a mould fungus, and this loss can be prevented, provided necessary precautions are taken. Although this matter was dealt with last month, it is of such vital importance to our citrus growers that it is necessary to again refer to it.

In the first place, growers must clearly understand that specking cannot occur on perfect fruit, the skin of which is free from injury of any kind. The fungus causing specking can only obtain an entry into the fruit through an injury to the skin; it will thus be seen that the remedy for specking is to take every possible care not to injure the skin of the fruit in any way.

Few growers realise how easily the skin of citrus fruits is injured, especially that of fruit grown under moist and humid conditions, when the skin is full of moisture and so tender that the least sign of rough handling causes serious injury, as the cells of the skin are so brittle that they are easily broken, and when so broken a ready means of entry for the mould fungus is provided, and specking follows in due course.

The remedy for specking is in the hands of the grower, who must learn so to gather, handle, and transport the fruit from the orchard to the packing-shed that it does not receive the slightest injury, and further, that when it has reached the packing-shed it must be carefully placed in shallow bins or on trays and be exposed to the air for at least seven days, so that the surplus moisture in the skin may be removed, and the skin thus becomes toughened and less easily injured. This drying of the skin is known as "sweating," and during the time the fruit is being sweated it should be kept under observation, and all fruit showing signs of specking or injury from fruitflies, sucking or boring insects, mechanical injury or bruising, should be removed.

In order to prevent injuring the skin when gathering, all fruit must be cut and not pulled. Gloves should be used to handle the fruit, and when cut it should be placed in padded baskets or other suitable receptacles. Any fruit that falls or is injured in any way should be rejected, as it is not fit to send to a distant market. At the same time, if the injury is only slight, it can be sent to a local market for quick sale.

For Southern markets only perfect fruit should be selected, and further, it must be graded for size, colour, and quality, and properly packed, only one grade of fruit being packed in a case. The cost of cases, freight, and marketing is now so high that only the best fruit will pay to send to the Southern States, and even the best fruit must be properly graded and packed in order to produce the best returns.

All orchards, vineyards, and plantations not thoroughly clean should receive immediate attention, as from now till the next rainy season the ground must be kept in a thorough state of tilth and free from weeds in order, in the first place, to retain moisture in the soil, and, in the second, to enable birds, ants, and predaceous insects to get at and destroy the pupæ of fruitflies and other pests harbouring in the soil.

Banana and pineapple plantations must be put into good order, and kept free from weed growth.

Land to be planted with trees should be got ready, as, if possible, it is always advisable to allow newly cleared land time to sweeten before planting.

Strawberries can still be planted, and the earlier plantings must be kept well worked and free from all weeds in order to get a good crop of early fruit.

Scrub land intended for bananas can be felled now, as there will be little more growth, and it will have ample time to dry off properly in time for an early spring burn. Do not rush scrub falling, as it is work that pays for extra care. Lopping will improve prospects of successful fire.

Keep a keen lookout for fruit flies, and on no account allow any fallen fruit of any kind to lie about on the ground unless you are looking for trouble with the ripening citrus crop. Keep the fly in check, and there will not be any very serious losses; neglect it, and there will not be much fruit to market.

The advice given with respect to the handling and marketing of citrus fruit applies equally to custard apples, pineapples, bananas, and other fruits. In the case of bananas handled by the Committee of Direction of Fruit Marketing, grading is now compulsory, and it will undoubtedly tend to stabilise the market for this fruit.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

Practically the whole of the fruit crop will have been gathered by the end of March, but several of the later-ripening varieties of apples grown in the Granite Belt may be kept for a considerable time, provided they are free from fly or other pests and are stored under proper conditions. Varieties such as Jonathan can be kept for some months at a temperature of 31 to 32 deg., and later varieties, such as Granny Smith and Sturmer can be kept till apples come again if stored at the same temperature. At the same time, although storing the fruit at this temperature under artificial conditions enables them to be kept for many months, the fruit can be kept for a considerable period, and marketed from time to time as desired, by storing it in a specially constructed apple-house in or adjacent to the orchard where grown.

Such a store can be cheaply constructed in the side of a hill out of the soil of the district and slabs of timber. The soil will make excellent pisé for walls, and the roof may be constructed of slabs covered with soil. Such a store can be kept at a very even temperature, and if the air is changed during cool nights—not frosty nights—the temperature can be reduced to a low point—low enough to keep the fruit in good condition for many weeks.

All orchards and vineyards not already cleaned up must be put in order, and all weeds destroyed. Keep the surface of the soil stirred so as to give birds and insects a chance to get at any fruitfly pupæ, as it is necessary to destroy this pest whenever there is a chance of doing so.

Land intended for planting during the coming season should be got ready in order to expose the soil to the cold of winter, thus rendering it sweeter and more friable.

If there is any slack time in the course of the month, go over all surface and cut-off drains and put them in good order. Also, if during periods of heavy rain, soft or boggy spots have made their appearance in the orchard, do what draining is necessary, as badly drained land is not profitable orchard land, and the sooner it is drained the better for the trees growing upon it. Soft or boggy spots are frequently caused by seepage of water from a higher level. In this case a cut-off drain will be all that is necessary, but where the bad drainage is due to hard pan or an impervious subsoil, then underground drains must be put in. After draining, the land should be limed. Liming can be done now and during the following three months, as autumn and winter are the best times to apply this material.

When the orchard soil is deficient in organic matter (humus) and nitrogen, try the effect of green-crop manuring, planting the grey or partridge pea and manuring the ground for this crop with a good dressing of finely ground island phosphate or basic phosphate.

Where citrus fruits are grown, they should now be ready for marketing. If the land needs it, it should be given an irrigation, but unless the trees are suffering from want of water it is better to stick to the use of the cultivator, as too much water injures the keeping and carrying qualities of the fruit.

The remarks on the handling and packing of citrus fruits in the coast districts apply to the inland districts also, but these districts have an advantage over the coast in that, owing to the drier atmosphere, the skin of the fruit is tougher and thinner and in consequence the fruit carries better.

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The Current Issue.

The present position in respect to banana "Bunchy Top" investigations is fully reviewed in a report to the Minister (Hon. W. N. Gillies) by the interstate committee of scientists appointed recently to inquire into the causes of the problem its occurrence has created. The banana weevil borer is also the subject of a special report by Mr. J. L. Froggatt, B.Sc. Mr. C. T. White, F.L.S., in addition to his regular feature, has some interesting notes on two weed pests—one quite new—which are causing concern to farmers in some localities. Tables and appendices supplementary to Mr. Eklund's recently concluded series on Irrigation in Queensland are included in this issue. Mr. Shelton continues his instructive articles on breeds of pigs, and adds a special illustrated note on the serious losses to the bacon industry through careless and cruel handling of pigs in the saleyards and in transit to the factory. Fruit fly investigation in the Stanthorpe district is the subject of an important report by Mr. Hubert Jarvis. Mr. Quodling's notes on the Upper Burnett will interest prospective settlers in that region. Another very useful contribution is a special note by Mr. Edmund Jarvis, accompanied by a coloured plate, on beetles affecting sugar-cane. Other seasonal features add to the value of a good April issue.

Bacon Pig Classes at the Brisbane Show.

The pig schedule for the next Royal National Show at Brisbane in August next provides for the entry of a new class for bacon pigs of any breed. Conditions prescribe the entry of three pigs weighing, respectively, from 100 to 130 lb. None but prime quality animals will be eligible to win in this class, and they must have been fattened by and be the property of the exhibitor. Liberal prize money will be awarded successful exhibitors. This new class replaces bacon pig classes at previous shows, and it is created for the purpose of encouraging competition among bacon-pig raisers. A big entry is anticipated, for the bacon industry in Queensland is expanding rapidly and there is an ever-increasing demand from the factories for first-quality baconers.

Science and Agriculture.

Efficient protection must be afforded to those concerned in the producing industries, and Queensland should at once consider the necessary means of affording this protection, and the preparation of scientific workers in this field in the future. This was one of the conclusions reached by Professor Goddard, of the Queensland University, in the course of his presidential address at the first annual meeting of the Entomological Society of Queensland, at which the Acting Premier and Minister for Agriculture (Hon. W. N. Gillies) presided. In giving his reasons for this conclusion, Professor Goddard mentioned the difficulty of obtaining plant pathologists for work within the State. The Director of the Imperial Bureau of Mycology, he said, intimated, in the course of his visit to Australia last year, that it was impossible to train men for Australia, owing to the world demand, and that it was becoming more evident that we must train our own plant pathologists. The need for many plant pathologists is becoming acute. Sketching the policy of the Entomological Society, Professor Goddard pointed out that the work of the society is bound up with entomological problems of economic interest and grave national concern. Success in attempting to unravel these problems can be hastened, and even in some cases made possible, only by the co-operation of investigators, whose interests to a very large extent overlap, or are of such a nature that a mutual interchange of ideas or mutual criticism of methods is essential to progress. Mutual co-operation is thus essential to the progress of economic entomological research viewed from the national aspect. It was, he said, with this idea in view that the Entomological Society had been founded, and the doings of the past year gave good grounds for anticipating a very useful career of work. After a brief mention of some of the well-known problems just now confronting producers in the various fields of land industry, and emphasising the enormous losses involved, he went on to say that any individual who has the disposition to measure the requirements necessary for national existence in and development of the Commonwealth must recognise that it is of the greatest importance that we retain perspective on national lines (as between primary and secondary industries) and not only recognise, but assimilate and constantly apply, the fact that Queensland, in common with other States of Australia, has been adapted by Nature to be fundamentally and essentially a country of primary production. Another conclusion drawn from a noteworthy contribution to current thought is that it is absolutely necessary to provide for education in the higher branches of agriculture if Queensland is to be provided with such experts as are essential to the security and progress of her great basic industries.

As Others See Us—Australia from a New Viewpoint.

An excerpt from an article in the ''Century'' magazine (January, 1924) by Alfred Pearce Dennis, Special European Representative, United States Department of Commerce:—''One may take as a simple illustration the most primitive form of agriculture in one of the most remote and lonely spaces of the earth's surface. The Australian shepherd, who conserves hay and roots for feeding his flocks during the winter, has hardly risen from the pastoral to the agricultural stage of human culture. He would seem to represent the ultimate in economic independence and isolation. Here is a man whose trade is older than that of Ishmael, and whose habits remain substantially unaltered since the day of the Aryan dispersion. Yet the welfare of this lonely shepherd, roaming the wide spaces of earth, is intimately bound up with a circumscribed industrial region in a smallish island on the other side of the globe. When the British Government in 1919 unloaded its accumulated wool stocks on the market, the Bradford spinners quit importing, and there was not a sheep-herder on the lonely plains of New Zealand, Australia, and Argentina who did not feel the pinch of hard times.'' Comment would be superfluous, but it is interesting to compare this most amazing view of Australia and the lives of ''her lonely shepherds, roaming the wide spaces of the earth,'' with the following paragraph in the ''Brisbane Courier'' of 12th February, 1924:—''The usefulness of the aeroplane has been demonstrated in the present floods in the Western creeks and rivers, and machines are being used in the carriage of mails and passengers over the rivers, while in some cases shearers are being conveyed to their depôts.''

INVESTIGATION OF "BUNCHY TOP" DISEASE OF BANANAS.

Following is a report of a committee appointed as the result of an agreement between the Commonwealth, New South Wales, and Queensland Governments to investigate certain aspects of the bunchy top disease of bananas and made available by the Acting Premier and Minister for Agriculture and Stock (Hon. W. N. Gillies).

Terms of Appointment.

The chief relevant clause of the joint agreement is: "That a scientist representing each of the parties concerned should form an Advisory Committee to inquire fully into the investigations which have been made in the past, to advise as to the existing position, and to make recommendations to each of the three Departments concerned as to further investigations."

More explicit instructions were contained in our letters of appointment dated 5th February, in which the following paragraphs occur:—

> "In addition to reviewing the past and present position regarding bunchy top, it is desired that the committee will make recommendations as to the general lines of future research, and will suggest suitable qualifications for the necessary research officers and their assistants and the scheme of organisation necessary for the control of the work, and will indicate persons possessing those qualifications and available for the work.
>
> "It is also part of the scheme that the committee shall render its report not later than about the 1st March."

Proceedings and Itinerary.

The committee held its first meeting at the School of Agriculture, Sydney University, on Tuesday, 19th instant, when a programme was outlined which would enable it to acquire the necessary information for this report. On the following morning, the committee had a long interview with Dr. G. P. Darnell Smith, Biologist to the Department of Agriculture, who has done much more work on the problem than anyone else, and who had already furnished us with valuable reports. In the afternoon we inspected the glass-houses recently erected in the Botanic Gardens for the use of Dr. Darnell Smith and his staff, and left for the Tweed the same evening. We arrived at Murwillumbah late on Thursday night, and spent the following day inspecting banana plantations to the south of Murwillumbah, including those of Mr. Roberts and Mr. Wells on the Soldiers' Settlement at Mullumbimby, and the promising young plantation of Mr. Lyons at North Burringbar. In the evening we had interviews with Mr. F. C. Smart, President, and Mr. F. W. Stuart, Secretary, of the Murwillumbah Fruitgrowers' Association, and Mr. P. Hunter, Director of Soldiers' Settlements in the North Coast district, who supplied us with valuable information.

On Saturday, 23rd instant, accompanied by Mr. E. A. Brown, we inspected a number of plantations in the Tweed Valley, including those of Mr. Marks and Mr. Sutton, of Terranora, and Mr. Brown, Mr. Anthony, and Mr. Tierney, of Barney's Point, on all of which a considerable amount of field experimental work on the treatment of the disease has been carried out. In the evening we gained some further useful information from Mr. Smith, Secretary of the Tweed Heads Fruitgrowers' Association, and a few local growers. The following morning, under the guidance of Mr. F. C. Smart, we visited the Bilambil Soldiers' Settlement and made a close inspection of Mr. Ormsby's plantation. In the afternoon we were joined by Messrs. Williams and Collard, of the fruit inspectors' staff of the Queensland Department of Agriculture, and proceeded to the productive plantation of Messrs, Skinner and Morley, and called in to see a young plantation on the farm of Mr. Dean of Cobaki.

Starting from Coolangatta on Monday morning, and still accompanied by Messrs. Williams and Collard, we inspected a number of plantations in the Currumbin district, including those of Mr. Allen, Mr. Freeman, and Mr. Moorhouse, which were stated to be representative of the plantations in Southern Queensland, and arrived in Brisbane the same evening.

The greater part of Tuesday was spent in interviews with Messrs. H. Tryon, J. C. Brünnich, A. H. Benson, G. Williams, H. Collard, and R. W. Peters, of the Queensland Department of Agriculture, Mr. Freeman, a large grower who had

previous experience of banana growing in Fiji, and Mr. R. G. Bartlett, who had previously been an officer of the Fruit Branch of the New South Wales Department of Agriculture in the North Coast district—all of whom afforded useful information, especially regarding the condition of affairs in Queensland, and made valuable suggestions. Late in the afternoon we motored out to the newly-infected area at Brookfield, on the north of the Brisbane River, where we saw unmistakable signs of the occurrence of the disease.

On Wednesday, we had some further interesting evidence from Mr. W. B. Christie, one of the banana industry representatives on the Fruit Marketing Committee.

Devastating Effects of the Disease.

We thus had more than a passing glance at the ravages of bunchy top as we traversed the country from Mullumbimby, on the Brunswick, to Currumbin across the border, and heard from growers on their own plantations their experiences of this terrible scourge. All three members of the committee are agreed that we have never seen in any country more calamitous effects to a flourishing industry brought about by a plant malady. No plantation visited was free from the disease; many had been completely wiped out by it; many more were on the point of being abandoned, while even the majority of the men who had suffered least were convinced that they would be "down and out," as far as banana-growing was concerned, unless some preventive measure was forthcoming in the near future. Before the disease appeared, the beautiful valley of the Tweed and its environs must have presented a most attractive picture, with its volcanic hillsides dotted over with flourishing banana groves. To-day, in spite of the great natural scenic beauty, the feelings engendered are akin to despair as the productive lands are gradually being replaced by a weed-grown wilderness, and a thriving rural industry threatened with extinction.

Symptoms.

The symptoms of bunchy top are very characteristic. The leaves of the affected plant are shorter and narrower than normal. They become bunched at the top of the pseudo-stem, owing to the failure of the leaf stalks to elongate. As a consequence, the expanded leaves are more erect than in a healthy plant.

The individual leaf of bunchy top plants shows, besides this dwarfing, several characteristic features, such as abnormalities in colour and texture. They are—

(1) The appearance of dark green streaks on the midrib and on the leaf stalk adjoining. These lines may vary from small spots to two inches in length. According to Dr. Darnell Smith, this is the first infallible sign of bunchy top. It is most easily seen after the white bloom, which covers a portion of the young plant, is rubbed away.

(2) Irregular, nodular lines of dark green colour that run between the main veins, particularly at the base of the leaf blade. In the normal leaf, the whole area between the main veins is faintly lined by secondary vascular strands. These lines are of even width and show no marked colour difference. In the affected plant these fine lines are frequently replaced by some two to five irregular and stouter lines which appear gorged with green colour.

(3) As the bunchy top leaf grows, it remains paler than the rich green of the normal plant, gradually assuming a more yellowish hue.

(4) The surface of the mature bunchy top leaf becomes markedly corrugated.

(5) There is a difference in the texture of the bunchy top and healthy leaf. The former is brittle and easily crushed in the hand, when it makes a characteristic crackling noise, having none of the elasticity of the normal leaf.

Such symptoms may be shown by leaves produced on suckers of any age from their first emergence from the ground to fully grown stems throwing a bunch. Cases have been observed in which bunchy top has not become apparent on a shoot until a bunch is emerging or even hanging exposed. In this case there may be no leaf symptoms, but the inflorescence shows green tips at the apices of the normally purple bracts. The fruit, where any is produced, is stunted and abnormally brittle.

Abnormal changes are to be seen in the root system. The healthy banana plant has roots of two types; (1) A spreading system of white fleshy roots, and (2) a large number of fine lateral roots borne upon these. The lateral roots are principally

concerned with absorption; they are comparatively short lived and normally die in acropetal succession. The main roots of affected plants are usually duller in colour and have purple patches upon them. They rot basipetally. The lateral roots appear unhealthy or withered and may be dead before the decay of the main roots involves them.

Dr. Darnell Smith has described various pathological changes observed on cutting open bunchy top plants. Some of these we saw, but it was not possible to make sufficient observations upon them to express an opinion as to their constancy. Such are the development of yellow to red-brown or black streaks accompanying the vascular strands which are shown on cutting across an affected corm, the less rapid development of a purple colour upon cut surfaces of the affected stem, differences in the consistency of the sap from affected and healthy plants, and so on.

It was no part of the duty of the committee to investigate the disease microscopically. This fact and the shortness of time prevented our making observations upon the many points of pathological interest that we observed. In Brisbane, however, fresh material of bunchy top and healthy leaves was obtained from Brookfield, and examined microscopically. From this examination it was abundantly clear that there is in the bunchy top plant a profound modification of the normal structure. These modifications of tissues which give rise to the first symptoms of bunchy top must have originated in the leaf during development. Hence, a plant which is said to become bunchy top rapidly—*e.g.*, on the expansion of leaves after rain—does not really do so, for leaf abnormalities must already have begun to develop before the leaf expanded. The modifications observed are not, in the ordinary sense, lesions or disease spots such as are produced by a fungus or bacterium attacking that particular area. They are rather the visible sign of abnormal developments in the leaf tissues, which interfere with the physiology of the leaf. It is clear to us that a critical microscopical comparison of the healthy and affected banana plants will be of much interest in the subsequent investigation.

Effect of Disease upon Growth of Plant.

A plant affected by bunchy top does not necessarily die rapidly. On the other hand, we have seen may affected stools that were of considerable size and looked remarkably vigorous. If a sucker or young plant is attacked it may die, or be rooted out or choked by weeds. The stool of an older plant may persist for some seasons, throwing fresh affected shoots. In his reports, Dr. Darnell Smith, has recorded that bunchy top shoots may rot off owing to the accumulation of water in the funnel-like top caused by the obliquely ascending leaf blades. This we have frequently observed, but we have also seen quite old bunchy top stools in which such a rot is not a feature of the malady.

From bunchy-top stools there may arise shoots that appear healthy. This we have been told on more than one occasion by men on whose powers of observation we we feel we can rely. Moreover, we ourselves have seen in plantations that were abandoned because of bunchy top shoots arising from badly affected stools that appear healthy. These have developed since the recent rains. Such plantations were evidently thought sufficiently hopeful by their owners, who had neglected them for a time, to justify the resumption of cultural operations. Such cases of apparent "recovery" on the part of occasional suckers from bunchy top plants are quite possibly merely temporary, but it is not impossible that from them bunchy top-resistant strains might be obtained. Only observations over a period of time could determine this point, but we feel that they are worth making. Our evidence suggests that this was one of the methods employed in Fiji to overcome the epidemic.

History of the Disease in Australia.

The disease was first noticed in New South Wales more than ten years ago, and appears to have spread from one centre in the Tweed area in all directions. In making this statement, which is generally borne out by the evidence of numerous planters, the mysterious nature of the disease is kept in mind and no prejudice in respect to the cause of the disease is exercised.

A certain grower, suspicious of the health and appearance of his plants, forwarded some specimens to the Agricultural Department of New South Wales for examination. Nothing in the nature of disease was detected in these specimens, and for a time the generally accepted explanation of the malformation of such plants was that it was due to some influence of a local nature. The extension and persistence of the trouble, however, eventually led this grower to refuse to supply suckers to other planters. From numerous planters who gave evidence before the committee it was gathered that it was generally believed that the disease had emanated from the

neighbourhood of this particular plantation. The disease became known first as "Cabbage Top" or "Curly Top," and later as "Bunchy Top."

During the last six years it has spread through the district, attacking plantations separated by miles from previously affected areas. Isolation gave no protection, and the rapidity of distribution and the varied and sporadic intensity of the disease baffled the planters, many of whom, on the appearance of the disease in their neighbourhood, foresaw the ultimate destruction of their entire plantation. It became quite a habit for planters to estimate at a minimum the life of a plantation once the pest had made its appearance. It seems to have early become very well established at Terranora, and to have ravaged that area in most parts with great intensity.

Despite the efforts of fruit experts, scientific experts, and the planters, the disease continued its march, until it was recognised that in New South Wales the banana industry appeared to be doomed; nothing seemed to prevent the disease from spreading to the more southern areas and repeating the ravage accomplished in the Tweed district.

An attempt to prevent the disease from extending further South was made by establishing a buffer area. Such was effected at Byron Bay, and as no plants to the north of this area were allowed to pass to the South, and a natural barrier existed in the neighbourhood in the form of a mountain range free from banana cultivation, it was hoped that by this means the distribution of the disease would be limited. Despite these precautions, the disease made its appearance in 1922 at Bangalow and in the neighbourhood of Lismore, and has been recorded from the Richmond River area during 1923.

The first record of the disease in Queensland was made about eight years ago at Currumbin. One planter, with considerable experience in banana growing in Fiji immediately prior to settling at Currumbin, informed the committee that he obtained corms from the neighbourhood of the plantation where the disease had been detected in New South Wales, the owner of this latter plantation acting in a noble spirit in refusing to dispose of plants to new planters. A very large proportion of the young plants very soon showed signs of disease, which was at once recognised by him as bunchy top, so familiar to him in Fiji. Replanting was necessary, and the plants for this purpose were obtained from another source. No sign of bunchy top was seen in these for three years.

A plantation adjoining was stocked with material from the same source in New South Wales, and of the 1,000 plants the greater number showed bunchy top. After replanting with stock from Samsonvale no bunchy top appeared until after three years.

The evidence of this planter, supported by that of other planters, seems to indicate that the first record of the disease was made from a plantation which had been stocked with affected material from a definite centre in the Tweed area.

The disease has spread through the banana-growing areas of South-Eastern Queensland in a manner comparable to that of the Tweed area of New South Wales. The seriousness of the epidemic was soon recognised by the planters. Immediately the disease was detected at Currumbin, it was suggested that the services of an Entomologist should be enlisted, and Mr. Tryon visited the Tweed (Terranora), in New South Wales, and Currumbin, in Queensland.

The disease became more and more widely distributed, and it became quite clear that the banana areas of South-Eastern Queensland were in grave danger of extinction. Early in 1920 it was suggested that experimental plots were necessary for the carrying out of manurial experiments. Visits to the area were made by the Government Fruit Culture Expert, Chemist and Plant Pathlogist during 1921, and it was recognised that the manurial experiments should be replaced by entomological and pathological investigation. Towards the end of 1922 it was reported that at Currumbin and Tallebudgera 112 plantations, representing 1,250 acres, were affected in varying degree, and it was urged that a scientific investigator should be stationed in the area. The matter of bunchy top was at that time still being investigated by Dr. Darnell Smith in New South Wales.

On 9th September, 1921, the Queensland Government issued a proclamation which prohibited the removal of any plant of the genus *Musa* (banana) excepting only the fruit thereof, from or out of any nursery, orchard, or other place in Queensland beyond an area defined as "The South Coast Fruit District."

The progress of the disease in the south-eastern areas and the impending danger to the areas north of the Brisbane River led to an agitation for the erection of a

buffer area. This was considered impracticable in view of the heavy compensation which would be involved and, further, as a strong natural buffer area had proved to be useless in New South Wales.

On 22nd December, 1923, the Government issued a proclamation rescinding that of 9th September, 1921, and proclaiming a wider area over which the restrictions embodied in the earlier proclamation would be exercised. In doing so, it was hoped that it might be possible to prevent the march of the disease north of the Brisbane River.

In February, 1924, the disease was recorded at Brookfield, north of the Brisbane River, the nearest area of infection previously recorded being distant between 40 and 50 miles. The committee visited one of the plantations at Brookfield and saw quite a number of diseased banana plants. There can be little doubt that the Brookfield records will be multiplied on systematic inspection of the plantations.

There can be little doubt in viewing the history of bunchy top in New South Wales and Queensland that the disease has been primarily distributed from a definite centre in the Tweed district. The distribution has been facilitated by the transfer of young plants and corms from this centre, there being definite proof that such a source of supply was available for the stocking of new and young plantations.

Bunchy top has been known in Fiji for more than forty years, and there can be no doubt that the Fijian disease is identical with that known to-day as bunchy top in New South Wales and Queensland. The disease still exists in Fiji, but, despite the destruction effected by it since 1885, is, according to evidence given before the committee by a planter with nearly ten years' experience in the industry in Fiji, no longer regarded as a serious menace. The prevalent idea, according to this witness, is that the disease had spent itself in those islands. In certain local areas the disease appears under suitable conditions, as on flat lands when flooded, but the suckers from such affected stools do not develop the disease in mosts cases. There can be little doubt that the disease still exists in Fiji. According to the evidence of many planters, banana stock was imported into the Tweed area from Fiji and planted at a spot where some short time later bunchy top is reported to have appeared, this being one of the earliest occurrences, and possibly the first, in Australia. This locality fits in with the central area from which the disease appears to have extended over the Tweed area, and, further, supplied much banana stock to Southern Queensland.

The evidence available thus renders it highly probable that bunchy top was imported into Australia from Fiji.

Present Position.

The banana industry in the affected areas is to-day in a hopeless condition, and, unless something unexpected intervenes to stay the progress of the disease, it would seem evident, in the present state of our knowledge, that there will be an extension of the region to embrace the plantations further north.

Barriers and buffer areas, in the light of experience, appear to be of no avail. Throughout the recent tour among many plantations only three were seen where the disease played, as yet, a minor part. Certainly these plantations had been well prepared before planting, were on excellent soil, had an aspect which could be regarded as ideal for banana culture, and were well cared for. Yet, in many other plantations in which everything appeared to have been done to ensure good results, the disease was rampant.

There have been numerous visits to all parts of the affected areas by scientific men and fruit experts, both in New South Wales and Queensland, and any suggestions made have been tested out by the planters, and many of these men have carried out a vast number of experiments independently.

The position to-day is that it is generally recognised that all efforts are being made in the dark. As time went on, every working theory collapsed, and now the planters recognise that they are in the hands of fate.

Experts cannot but profess ignorance in respect to the cause of the disease and cannot advise planters to follow any particular course, as the experiences of one planter, who has done all that neighbours on less affected plantations have done, indicate that we are dealing with a disease whose vagaries, in the present state of our knowledge, are inexplicable.

The position is well summed up in the statement (made by a grower whose plantation has been affected to only a minor extent) that "everything does good, but

in the end bunchy top will come out on top.'' One grower, with considerable experience in the industry in Fiji and Queensland, whose plantation has so far been affected to a minor extent, is strongly of the opinion that the disease will spend itself as in Fiji. He adopts the practice of selecting suckers from affected stools when planting, thinking that thereby a ''salting down'' of the disease would be effected. Yet, although optimistic in respect to the ultimate fate of the disease, he recognises the terrible devastation at one time brought about in Fiji, where the problem was not investigated on a scientific basis. This grower, like all others, is strongly of the opinion that the position of the industry at present is perilous, and that any help which may be of use to the industry must come from scientific investigation.

A very large proportion of the plantations has been wiped out, and in most of the others the struggle is markedly in favour of the disease. It is quite common among the majority of growers to estimate the time which will elapse before a plantation will cease to be a financial proposition.

With faint qualification in favour of those plantations where ideal conditions and culture obtain, it would appear in the present state of our knowledge that luck is on the side of those growers whose plantations are still affected to only a minor extent.

Economic Effects of Bunchy Top

The most obvious losses caused by the disease are those sustained by individual growers, which losses have frequently been extremely serious. Many men who started growing bananas after bunchy top had made its appearance, but had not assumed the proportions of an epidemic, lost practically all the capital they had invested, although others, who had a few good years behind them, came through the financial ordeal fairly well. Apart from that, the cumulative effect of these individual losses means a great deal to the State in the shape of decreased returns in income tax, railway revenue, and many other ways. We were supplied with reliable figures illustrating this, only a few of which need be quoted.

The number of cases of bananas railed from Tweed Heads for the last three years ending 30th April has been as follows:—

1921-22	143,000
1922-23	131,000
1923-24	under 50,000

in spite of many new plantations coming into bearing each year. Similar figures for the month of January in the last two years were—

1923	12,000 cases.
1924	3,500 cases.

The total output in the Currumbin district has dropped from 100 tons per week to 40 tons, in eighteen months.

One grower, whose books we examined, sent away from his 14-acre plantation—

1921	3,725 cases.
1922	3,500 cases.
1923	1,670 cases.

and in another six months he expects to be down to nothing, as his plantation is over 80 per cent. ''bunchy.'' Another stated that his production had dropped from 50 cases a week to 5 within two years; while still another was producing up to 140 cases a week two years ago and to-day his production has dropped to nothing.

Well authenticated yields of over 300 cases per acre are on record, and a gross revenue of £2,000 a year from 10 acres of bananas has been obtained in one instance before bunchy top appeared. In some of these cases the productive land has now gone out of bananas or is in danger of going out with bunchy top altogether in a few years or even months. The acreage under bananas in New South Wales showed a steady increase from 2,040 in 1915-16 to 5,740 in 1920-21, but has declined to 3,800 in 1922-23 owing to the effects of bunchy top. Before the effect of the disease was felt, the average farm value per productive acre in New South Wales varied from £55 to £62 per acre—a figure which greatly exceeds that of any other crop grown extensively in New South Wales or Queensland.

There is another economic and national aspect of the question. From every point of view it is eminently desirable that the number of primary producers in Australia should be greatly increased. Banana growing, until recently, provided an excellent opportunity for successful closer settlement on small areas. It was, doubtless, this fact which induced the authorities to establish several soldier settlements in New South Wales with banana-growing as a main occupation. We visited two of these soldier settlements—one at Mullumbimby and one at Bilambil. At the former thirteen ex-service men were settled on banana blocks of about 20 acres each. To-day only six remain, and it appears certain that this number will be further reduced in the near future owing to the havoc caused by bunchy top. Indeed, it has been decided to turn the blocks into dairy farms, which will require a much larger acreage and will give a very much smaller production per acre. At the Bilambil settlement, thirty-six out of the thirty-eight original soldier settlers still remain. When it was started, it looked like developing into the best soldier settlement in Australia, and such it would doubtless have proved had not the dreaded bunchy top made its appearance. Unless some remedy is found very soon it will also have to be redesigned for dairying, for which purpose it is much less suitable. These two settlements represent only a fraction of the trouble, as there are other settlements and "single-soldier blocks" scattered all through the chief banana-growing centres. The loss to the national exchequer incurred in this way, mainly through bunchy top, promises to be quite serious.

When the banana industry was at its zenith a few years ago, very high prices were paid for suitable land, up to £150 per acre for land covered with lantana, and up to £300 for bearing plantations. Such prices were actually justified by the returns of the growers at the moment, but when bunchy top affected the crop, the whole prospect was altered, as no other crop on such land would give a return commensurate with this high capital value. At the same time, much land that was not suitable to the rather exacting requirements of the banana was planted, and this may have contributed in some measure to the reduced returns sometimes attributed to bunchy top.

It would be difficult indeed to estimate the total economic loss caused by this mysterious plant disease, but, in the opinion of growers as well as the committee, it is great enough to warrant the expenditure, on the part of the Commonwealth Government and affected States, of an even larger sum than that agreed upon at present.

History of Investigations in Australia.

The "Agricultural Journals" of New South Wales and Queensland contain several references to bunchy top, extending over the past four years. Strictly speaking, these represent the only literature available for a student of the disease. However, we have had placed at our disposal a number of reports from various officers of the Agricultural Departments concerned. As the committee is asked to report fully, and, presumably, in an *ex parte* manner, upon the investigations that have been made in the past upon bunchy top, we feel that we should be failing in our duty were we not to say that there has been a regrettable amount of delay in investigating this serious disease in the thorough manner that it warranted. We find that various officers in the Departments concerned were fully aware of the potential danger of the trouble, at least as far back as June 1921, and asked that a man be detailed to investigate it. Apparently, this was found impracticable. Possibly, some of the difficulty arose from the fact that the outbreak began to assume epidemic proportions at the border of two States; thus delay was occasioned in concerted action. In New South Wales, Dr. Darnell Smith has devoted much time to the problem. As scientific investigators ourselves, we fully appreciate the difficulties under which he worked, but we feel that much valuable time would have been saved, and probably great financial loss averted, had he, or some other qualified person, had the time and facilities placed at his disposal for a thorough investigation of the problem in a field laboratory. A scientific investigation can only be expected to give results of permanent value if it be conducted along carefully considered lines and the investigator has at his disposal the requisite apparatus and other facilities. This we consider has not been the case, and in consequence the results obtained are disappointing and in some cases invalid. To avoid misunderstanding, we would specifically state that we attach no blame to any individual, Department, or Government. All probably have been the victims of circumstances, but the fact remains that a flourishing and remunerative industry has been brought to the verge of ruin in some areas, while the whole of the banana-growing districts of the Commonwealth are threatened. From an economic and commercial point of view, as well as from a scientific, the problem will be much more difficult to solve now than it would have been even three or four years ago.

The first published account of bunchy top in Australia known to us is in an article in the "Agricultural Gazette" of New South Wales (xxx., p. 809, 1919) on "Bunchy Top in the Tweed District." The disease was even then a very serious one in the area. In the article is a list of symptoms together with a discussion of possible causes. Bunchy top was regarded as due to root decay, with an indication that the decay might be due to drought or flood or both in sequence. The possibility that it was a result of a "running out" of the corms planted was mentioned. But in the main, bunchy top was regarded as due to faulty root development, and was stated not to be contagious. It was suggested that in some respects cultural practices along the Tweed were not in accord with the best principles, notably that the plantations were too old, and that overcrowding was encouraged by too close planting. Dr. Darnell Smith recommended that growers should take suckers from healthy plants only, and also that new strains be imported from a more tropical country.

In 1923, Dr. Darnell Smith published his second paper ("Agricultural Gazette," N.S.W., xxxiv., p. 846). In this account certain corrections and additions to his previous paper were made. Manurial trials and the importation of clean corms from the north of Queensland had shown that the disease could not be directly ascribed to either soil deficiency or to the "running out" of strains in general use. Bunchy top developed on both manured and unmanured plots and in plots planted with corms from a new source. In the interval, the suggestion that the disease was insect transmitted had come to the fore, aphis being specially suspected as transmitter. In the paper reference is made to trials of a kerosene emulsion spray, which is said to have reduced aphis attack, but not to have prevented the disease.

The committee has also had access to three reports drawn up by Dr. Darnell Smith, in one case in collaboration with Mr. H. Tryon. The first and joint report, which is summarised in the "Queensland Agricultural Journal," xix., p. 32, 1923, is the result of a conference and joint visit paid to the infected areas in the two States. As a result of their joint experiences, they state that they had not found any exclusive cause of the malady and that, moreover, explanations put forward without experimental evidence had failed to advance our knowledge of the subject. However, as a result of the New South Wales investigations, these observers stated that many of the theories put forward could be dismissed. These were that bunchy top was due to—

(*a*) Soil depletion.

(*b*) Loss of vigour on the part of the plants owing to continued planting of one strain, popularly called "running out."

(*c*) Soil acidity.

(*d*) Soil contagion, the planting of disinfected corms in soil treated with certain fungicides having failed to prevent the disease.

(*e*) Definite parasitic action. So far no parasitic organism had been isolated which could produce bunchy top under experimental conditions. This inquiry was stated to be still in progress.

(*f*) Animal parasites. Nematode worms, which had been suspected by some observers to be the cause, being not consistently present on bunchy top affected plants. Infection by aphis was then being tested.

(*g*) Harmful climatic factors in the district.

(*h*) Chemically injured soil owing to the effect of banana crops since the scrub was cleared.

The report concluded by emphasising the need for further scientific work on bunchy top in both field and laboratory. Field laboratory accommodation was considered necessary. The need for the co-operation of an Agricultural Chemist and also for the help of an Agricultural Officer who should be detailed to assist the investigation was stated.

In August, 1923, Dr. Darnell Smith presented a further report. This gives a more detailed statement of his field and laboratory experiments. Reference is made to fungus and bacterial organisms obtained from bunchy top affected plants, though the connection of these with the disease, if any, could not be established owing to lack of facilities.

Lastly, in February, 1924, Dr. Darnell Smith presented a fuller report that brings the investigation up to date. It can serve no useful purpose to summarise, in this place, the information contained therein. The report shows clearly how much

is left to be done to arrive at a proper understanding of the disease. The author advances a number of reasons that have led him to arrive at the opinion that the cause of bunchy top is to be found in the corms or roots. In order to account for the sporadic appearance of the disease, he considers that the organism, whatever it may be, has periods of active parasitism followed by others of dormancy, when it may be saprophytic. This he concludes because, when an area is newly planted, some corms may go "bunchy" in eighteen months, others only after three or four years. A considerable part of the report deals with experiments on possible insect transmission that had been conducted by Mr. Marks, of Terranora, and others under the suveillance of the Department of Agriculture. These had proved a failure, as had certain manurial trials. The latter part of the report contains reference to possible parasitic fungi and bacteria, drought effects, the possible existence of immune varieties, the question of dealing with unprofitable plantations, and the occurrence of bunchy top in other countries.

In Queensland the work accomplished has been more limited. There has been a tendency to await results from New South Wales, which is comprehensible from the point of etiquette as well as economy. Manurial trials at Currumbin in 1921 proved useless in checking the disease and were abandoned. We are, however, impressed by the serious way in which certain officers in Queensland regarded the problem, and urged the appointment of an investigator to be stationed in the field.

No account of what had been done in the way of attempted cures of bunchy top would be complete were not reference made to the considerable amount of experimentation that has been done by the growers themselves. Some of this body of men, who day by day have seen their livelihood slipping from them, have experimented widely with various manures in the belief that soil deficiency might cause the trouble. Others, actuated by the belief that a soil organism was concerned, have tried so-called remedy after remedy with the energy to be expected of desperate men. It was picturesquely stated by one of them that everything "from Epsom salts to gelignite" had been tried. After the many specifics of which we have heard, we feel that this may not be the exaggeration that it appears. Such empirical trials, of course, have no scientific value, but they do show that the men concerned realised that they were fighting an enemy in the dark—an enemy that must be overcome or they themselves would go under.

In a rather different category come certain more serious experiments such as those of Mr. E. A. Brown, of Barney's Point, Mr. Brooks, of Highfield, and Mr. Marks, of Terranora. Mr. Brown, after the trial of many manures which were without avail, believed that acidity was the cause. This he has attempted to correct, but without success. Mr. Brooks, believing that a soil organism was concerned, attempted to protect his plants, first by sulphur and later by a Stockholm tar dressing on the cut surfaces of the corm. The result has been failure. Mr. Marks believes that, whatever the case, it is insect transmitted. Noting aphis in great numbers on his plants, he devised a treatment with kerosene emulsion. He was a competitor for the £5,000 reward offered for a cure, but his specific broke down under the conditions of the test imposed. From their observations, the committee feel doubtful whether aphides play any constant part in the transmission of the disease. On the other hand, we have no hesitation in saying that a method involving any form of spraying the plants is impracticable on most of the banana plantations that we have visited.

In fine, from a study of the papers at our disposal, we are at present in ignorance of whether the disease is due to fungus or bacterium, to a virus, or to some other cause. We do not know if it be insect transmitted or whether it infects from the soil or wind. The committee feels that the bunchy top disease is one calling for a full scientific investigation, and that empirical methods do not constitute the ideal way of attacking the problem.

Complexity of the Problem.

It is hard to conceive any plant disease of greater scientific interest and yet of greater complexity than bunchy top. Primarily, the investigations were carried out in field and laboratory. The observations in the field suggested many theories, but each of these has had to be given up as the sole explanation of the disease, as experience increased and support failed when tested out in the field and laboratory. The usual methods of the Plant Pathologist have been applied in a laboratory, far removed from the affected areas, and have led to nothing concrete. These results are not unique, as other plant diseases have offered the same difficulties. In the present state of our knowledge it is useless to exhibit any prejudice as to the cause and nature of the disease. It is very convenient for the scientific man to crystallise

his views on the malady by regarding it as a physiological disease or virus disease, &c. Bunchy top is baffling in respect to its cause and behaviour, and, until it is investigated in as thorough a scientific fashion as the value of the industry from an economic and national standpoint warrants, it is useless to theorise. The committee realises that any ideas as to the nature of the disease which it might attempt to describe in scientific language had, in their essence, already been born in the minds of practical planters, and that all practicable means of testing out had been tried.

In the case of Panama disease, although the organisms associated with the disease have been isolated—and in this case the primary organism is in doubt—no cure has been affected. The committee in recognising the importance of the fact that in any such investigation it is essential that every attempt should be made to diagnose the cause of the disease and that this should be made the primary object in view, yet bears in mind that the real business of the committee is to elaborate a scheme by which, if possible, the means of eliminating or controlling the disease may be discovered. The problem facing a Plant Pathologist is an exceedingly difficult one, and there can be little doubt that as the investigation progresses it will be necessary for him to have the co-operation and help of workers in other branches of science.

Fortunately, the growers appreciate that the problem promises to be difficult of solution and that the investigation may be prolonged, and towards the idea of such an investigation they manifest a marked spirit of co-operation. There is only one regret on their part in connection with such a scientific investigation by means of a scientist stationed in the area, and that is a universal feeling that the delay in attacking the problem in this way has been responsible for many unnecessary financial hardships to those concerned in the industry. The scientific work already accomplished, and the experimental work carried through in both States by Government officials and growers, has led to nothing definite—a position which was made quite intelligible to the committee during the tour through the affected areas.

There is in our possession too little knowledge to enable us to pronounce any one theory as meriting a status of high probability, nor is there any justification for differentiating at this stage between possible and probable causes. Any investigation must be prepared to meet with a complex in whose being cause and effect will be confused. Consequently, we feel that any pathological investigator must have thorough support from every scientific aspect.

Knowledge of the results of the investigations into Panama disease and some other plant maladies has forced on the committee consideration of the practical value of investigations along cultural lines. Such investigations might in the end become necessary if the work of a purely pathological, physiological, and biochemical nature did not lead to a diagnosis of the cause, or succeeded in tracing the malady to some definite organism or defect but failed to find a remedy. Evidence given before the committee strongly supports the idea that every attempt should be made to institute work along such lines with a view to producing an immune strain. Such investigations might well run parallel to the scientific laboratory work. In the present state of our knowledge in respect to bunchy top, and taking into consideration the alleged history of the disease in Fiji and the experiences of other plant diseases, it would appear that investigations of this nature open up as bright a field as might be expected from the purely pathological work.

It is interesting to note that most of the suggestions made in this section of the report occurred not only to the committee as the plantations were visited, but individually were mentioned by various witnesses who appeared before the committee. This serves to indicate not only the great amount of thought which had been devoted to the malady, but the keenness of the efforts to combat this elusive disease under conditions which, in our opinion, could not be expected to lead to any definite results.

Recommendations.

In concluding its reports, the committee has the honour to make the following recommendations:—

(1.) It is imperative that a thorough scientific investigation of bunchy top, having as its primary object the discovery of the cause, be made by a competent scientific man of high standing. The investigator should be given a two years' engagement, subject to revision and extension, if need be, at the end of eighteen months.

(2.) The qualifications required by the investigator are a good botanical training with a special knowledge of plant pathology. The investigator, however, will meet with problems of plant physiology and genetics amongst other branches of botany. He must therefore be a man of considerable training and experience.

(3.) The locality in which the investigator should work has received careful consideration. A laboratory is needed, and it should be adjacent to a banana-growing district. There must be water and electric current available in the district. We therefore recommend that the laboratory should be at Tweed Heads or Coolangatta in a small unfurnished house, rented for the purpose. The furnishings, chiefly tables, chairs, &c., will be a small item, and could be sold at the end of the investigation.

(4.) Adjacent to the laboratory must be a small area on which pot experiments upon infected plants can be made and insect-proof enclosures erected. This need not be larger than a vacant building block.

(5.) The investigator should have under his sole control an area of about 2 acres of the best banana land available in the district. This need not be in close proximity to the laboratory though it must be within easy access. We are assured that there would be no difficulty in obtaining such land for the purposes required at a purely nominal rental.

(6.) Various pieces of apparatus will be needed, the more obvious of these being—

Microscope, objectives, camera lucida, &c.;

Incubators and autoclave;

Steam steriliser for soil;

Camera, glassware.

Others will be suggested by the investigator, but at the moment we do not anticipate any considerable addition to these. The bulk of the apparatus will be available for dispersal at the close of the investigation.

(7.) Recognising that the investigator will need to travel widely at times in the infected district, we recommend that he be provided with a motor-car, which could be sold at the end of the investigation.

(8.) We have received most encouraging offers of co-operation from the officers of the various Departments with whom we have come in contact. We recommend that full advantage be taken of these by the Bunchy Top Investigation Committee and its workers. The question of preparation of the media required for fungus and bacterial culture has been considered. This is a tedious process unless a fully equipped bacteriological laboratory is available, when it becomes a matter of routine. If the investigator be stationed at Tweed Heads or Coolangatta, we believe that media could be prepared in Brisbane, which is comparatively close. Such an arrangement seems to us preferable to having it sent from Sydney, where Dr. Darnell Smith kindly offered to have it prepared in his Department.

(9.) The services of a man will be required to undertake the cultivation of banana land and also to assist in the laboratory with such heavy work as soil sterilising, shifting of pots, &c.

(10.) At present we consider one investigator will be sufficient, but there are certain lines of work in which he will need specialist assistance. We are assured by Mr. Brünnich that soil analyses from the banana lands can be undertaken in his laboratory. It may be, however, that the investigator will need the temporary assistance of a biochemist, an entomologist, or other specialist. Such assistance we do not consider would be required for so long as the two years allowed the Investigator-in-Chief and we have budgeted for it below accordingly. It is impossible for us at the moment to foresee exactly what temporary specialist assistance may be required, but we wish to make it clear that such help will in all probability be needed from time to time. When it is asked by the investigator there should be no undue delay.

(11.) A second line of investigation, that should be undertaken at once, is on the technical or growers' side. This should have as its object the cultivation and testing of bunchy top resistant plants in an endeavour to find bunchy top free strains. From its field observations the committee believes this to be a very hopeful line of work. This second full-time worker should be a horticulturist well acquainted with banana growing. He should be at the disposal of a Bunchy Top Investigation Committee (defined below) and work in conjunction with the investigator mentioned above. Even if there should, for any reason, be a delay in the appointment of the investigator, the horticulturist should be appointed and start duties as soon as possible.

(12.) We consider that the horticulturist should tour the whole affected area and obtain plants or suckers apparently resistant to bunchy top. These should be tried out in the experiment plot referred to above.

(13.) Your committee recommends that the horticulturist should be sent at an early date to Fiji and neighbouring islands in order to obtain: (1) Information as

to the history of the bunchy top epidemic in that country, and (2) corms of Cavendish or other suitable varieties of bananas, with a reputation for resistance to bunchy top, for trial in Australia. This tour we consider could be completed in three months.

(14.) There should be the closest co-operation between the investigator and the horticulturist. Both should be under a Bunchy Top Investigation Committee, the former being the senior officer.

(15.) For the management of the investigation we recommend the appointment of a Bunchy Top Investigation Committee, to consist of representatives of the three contracting parties. This committee, which should be ultimately responsible for the £4,500 allocated, would be the body to which the investigator and horticulturist would report and it would authorise unforeseen expenditure. We believe that the committee would not be required to meet very often, and that the investigator should be given the fullest possible amount of freedom in the carrying out of his task.

(16.) The committee has the honour to submit certain names of persons qualified for the duties mentioned above. There has been great difficulty in compiling this list, and the men suggested are at present engaged in important work which, if appointed, they will have to lay aside for a time. The qualifications of every man available in the Commonwealth have been considered. The list of possible men is very small, and it is a matter of concern to the committee that, having regard to the vital importance of agricultural pursuits in the welfare of this country, men trained to investigate the problems of plant disease are so few. We have no hesitation in saying that if the number of plant pathologists employed by various bodies in Australia could be triplicated, the expenditure would be amply repaid.

Acknowledgments.

Throughout the whole course of the investigation, the committee was almost overwhelmed by offers of assistance from Departmental officials, members of fruit-growing organisations, and private growers. It would be impossible to make individual acknowledgment of the services rendered by them without unduly over-burdening the report, but we feel that special mention should be made of Mr. Lyons, of Upper Burringbar, and Mr. E. A. Brown, of Barney's Point, each of whom put his car and himself at the disposal of the committee for a whole day, and of the Under Secretary for Agriculture and Stock at Brisbane for giving us the use of a room and supplying us with the services of efficient typists, who worked at high pressure in order to complete the report.

ROBT. D. WATT, Chairman.
E. J. GODDARD.
J. G. B. OSBORN.

THE BANANA WEEVIL BORER.

ENTOMOLOGIST'S REPORT.

The Acting Premier and Minister for Agriculture and Stock (Hon. W. N. Gillies) has made available the following report by Mr. J. L. Froggatt, B.Sc., Entomologist, on his Banana Weevil Borer investigations:—

I have the honour to submit the following reply to your communication of the 6th March, 1924, *re* my investigations into the Banana Weevil Borer problem:—

1. This research work has been in progress for three years, but the continuity thereof has received numerous interruptions, in many cases due to lack of laboratory facilities.

2. As a result of the observations, a great deal of valuable information has been obtained on the life history and habits of the pest, which has been found to have two main breeding periods during the year, covering the months of spring and autumn. During winter the beetles are comatose, and in the summer are dormant.

The beetles have shown themselves, under natural conditions, to be abhorrent of light. On account of this fact, actual observation of the movements, &c., of the weevils is virtually impossible.

The life of the beetles is a very prolonged one under natural conditions, extending over considerably more than one year. Without food, in moist soil, they can live for several months, but this appears to be governed, to a certain extent at any rate, by the time of year. This has important bearings on the problem, and requires further study.

The action of various poisons on the adult beetles has shown a marked variation as between the active and inactive periods under laboratory conditions, being much more regular in the former than in the latter. For this reason, the experimental work along this line of investigation has had to be confined to the active periods, necessitating a much longer time being taken over the tests than would otherwise have been the case. Poisoning baits with Paris green appears to offer a great simplification of the old trapping methods. Whether this poison is the most satisfactory that can be used or not cannot be decided until the whole of this work is completed.

It has been ascertained that breeding is continuous throughout the year, but the rate is much less during the inactive than during the active periods.

All old plant material lying on the ground, or left standing in the stools is needlessly helping to increase the numbers of the pest in a plantation, while it is in a healthy or semi-decaying condition. While it is in the least degree moist it also forms feeding grounds and shelter for the beetles. Cutting all this material up so that it is able to dry rapidly renders it totally unsuitable for breeding or sheltering in. The beetles are then forced into the stools, in which centres they can be more readily destroyed than when scattered broadcast throughout a plantation. This work of lessening the numbers of the beetles can never be wasted as it results in keeping the pest in check, especially when carried out in conjunction with the use of baits, preferably poisoned.

A considerable amount of work has been done on many lines of investigation without any positive result having been obtained. This has led to the expenditure of a great amount of time for no tangible profit from the growers' point of view, but such must always be anticipated in any scientific research work. The question of the flight of the beetles is one such line as would come under this category. Both laboratory and field tests which I have carried out myself, or have had carried out under my direction, have so far failed to show that the beetles fly. The statement has often been made to me that they do fly, but in only one instance, occurring early last month, has the statement been backed up by specimens. In this case the beetles were reported to have flown into the hut right alongside the plantation in the evening. What the conditions were governing this it was not possible to say.

From all my observations to date the powers of flight do not appear to be greatly exercised. This question is one which, owing to the beetle's normal abhorrence of light, is very difficult to follow. Any observations made by the banana-growers would be welcomed, particularly important being: (1) The beetles observed in flight being sent in; (2) time of day and date the flight was observed; and (3) climatic conditions.

It has been stated that any such flight "would render heaps of work done by 'tryers' more or less waste," referring presumably either: (1) To the present necessity of obtaining suckers free from the pest for planting; or (2) to the question of cleaning up the plantation.

As to (1) our knowledge of the factors governing the flight of the beetles is at present nil: it may be only exercised for a very short period of the year, and for short distances. *Re* (2) as stated previously this work can never be wasted.

Far more definite information is required before we can state to what extent the flight of the insect will affect the present practice of control.

I have briefly outlined a few outstanding results that have been obtained through my investigations into the banana weevil borer. To go fully into the matter, and show what lines of investigation had been taken up would entail considerable space, and has been dealt with in my articles in the "Queensland Agricultural Journal."

From the results obtained to date it has been found possible to formulate means of at least checking the pest if the scheme is conscientiously adhered to.

It is possible that from the work yet to be done other possible means of control may be obtained.

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Left to Right—

Front Row—

M. H. Campbell,
A. M. Whittenbury,
A. S. Walters (Pres.),
C. Kahl (Secretary),
H. Cutcliffe.

Second Row—

R. H. Woodcock,
W. G. Oxlade,
W. Hindes,
J. Harrington,
J. Beard (Government Poultry Expert).

Back Row—

F. Koch.
A. E. King.
S Lloyd.

PLATE 51.—DELEGATES TO RECENT INTERSTATE CONFERENCE OF THE NATIONAL UTILITY POULTRY BREEDERS' ASSOCIATION OF AUSTRALIA, HELD IN BRISBANE, 22ND, 23RD, JANUARY, 1924.

REPORT ON EGG-LAYING COMPETITION, Q.A.H.S. AND C., FEBRUARY, 1924.

In the course of the month a large percentage of the birds have been in full moult, also some of the competitors have not replaced birds that died, hence the falling off in the laying for February. There were two deaths, Mrs. Hodges losing her A bird through its being struck by a hailstone, while one of Mr. Ferguson's R.I. Reds died from bowel trouble. In the light breeds Mr. N. A. Singer leads with 118 eggs, and in the heavy breeds Mr. R. Burns leads with 120 eggs. His E bird laid 28 eggs for the month, placing her over the 300-egg mark. Mr. C. H. Singer's B bird also has laid over 300 eggs. Both birds are doing well.

The following are the individual scores:—

Competitors.	Breed.	Feb.	Total.
	LIGHT BREEDS.		
*C. H. Singer	White Leghorns	115	1,474
*W. and G. W. Hindes	Do.	116	1,468
*N. A. Singer	Do.	118	1,464
*Oakleigh Poultry Fa m	Do.	87	1,325
*Ancona Club	Anconas	96	1,263
*H. P. Clarke	White Leghorns	90	1,248
*S. L. Grenier	Do.	97	1,242
*R. C. J. Turner	Do.	94	1,230
*Beckley Poultry Farm	Do.	84	1,226
*Mrs. L. Andersen	Do.	107	1,224
*J. W. Newton	Do.	77	1,214
*Geo. Williams	Do.	82	1,153
*O. Goos	Do.	70	1,151
*Rock View Poultry Farm	Do.	63	1,143
*C. A. Goos	Do.	76	1,113
*Bathurst Poultry Farm	Do.	68	1,105
*Arch. Neil	Do.	60	1,087
*J. Purnell	Do.	97	1,077
*J. W. Short	Do.	60	1,058
*Mrs. R. E. Hodge	Do.	64	1,055
*J. M. Manson	Do.	30	1,051
F. Sparsholt	Do.	37	1,026
*H. Fraser	Do.	66	1,027
*A. C. G. Wenck	Do.	52	1,004
*N. J. Nairn	Do.	71	992
G. E. Rogers	Do.	61	962
Jas .Hutton	Do.	36	950
G. Marks	Do.	40	942
W. A. and J. Pitkeathly	Do.	52	932
W. and G. W. Hindes	Brown Leghorns	72	929
E. Ainscough	White Leghorns	56	920
W. Becker	Do.	27	908
Jas. Harrington	Do.	45	903
C. Quesnell	Do.	58	899
*Mrs. E. White	Do.	51	875
Parisian Poultry Farm	Do.	40	853
Chapman and Hall	Do.	26	833
Jas. Earl	Do.	38	825
	HEAVY BREEDS.		
*R. Burns	Black Orpingtons	120	1,386
*W. Becker	Chinese Langshans	76	1,284
*Mrs. A. E. Gallagher	Black Orpingtons	116	1,316
*Jas. Potter	Do.	76	1,279
*Jas. Ferguson	Chinese Langshans	92	1,263
*Mrs. A. Kent	Black Orpingtons	76	1,149
*E. Walters	Do.	75	1,146

EGG-LAYING COMPETITION—*continued*.

Competitors.	Breed.	Feb.	Total.
HEAVY BREEDS—*continued*.			
*T. Hindley	Black Orpingtons	80	1,143
*Parisian Poultry Farm	Do.	65	1,128
*Jas. Hutton	Do.	56	1,121
*E. F. Dennis	Do.	80	1,098
*C. C. Dennis	Do.	76	1,054
H. B. Stephens	Do.	74	1,048
J. R. Douglas	Do.	60	1,047
*H. M. Chaille	Do.	61	1,045
*R. Holmes	Do.	54	1,037
*J. H. Jones	White Wyandottes	83	1,019
W. T. Solman	Black Orpingtons	28	1,015
Beckley Poultry Yards	Do.	70	985
R. Conochie	Do.	42	983
W. F. Ruhl	Do.	70	960
G. E. Rogers	Do.	65	956
Rev. A. McAllister	Do.	43	915
V. J. Rye	Do.	65	863
Jas. Ferguson	Plymouth Rocks	37	854
F. J. Murphy	Black Orpingtons	61	831
W. G. Badcock	Chinese Langshans	36	809
Jas. Ferguson	Rhode Island Reds	33	690
Mos. Stephens	Black Orpingtons	28	645
Totals	..	4,477	71,220

* Indicates that the pen is being single tested.

DETAILS OF SINGLE HEN PENS.

Competitors.	A.	B.	C.	D.	E.	F.	Total.
LIGHT BREEDS.							
C. H. Singer	221	304	245	215	227	262	1,474
W. and G. W. Hindes	232	254	245	211	268	258	1,468
N. A. Singer	211	256	278	263	230	228	1,464
Oakleigh Poultry Farm	219	231	217	209	234	215	1,325
Ancona Club	192	224	263	176	186	222	1,263
H. P. Clarke	230	164	228	188	220	218	1,248
S. L. Grenier	178	216	240	204	203	201	1,242
R. C. J. Turner	196	208	203	200	192	231	1,230
Beckley Poultry Farm	204	191	185	218	212	216	1,226
Mrs. L. Andersen	180	212	226	217	204	185	1,224
J. W. Newton	222	208	198	169	205	212	1,214
Geo. Williams	216	221	180	180	180	176	1,153
O. Goos	175	203	207	188	180	198	1,151
Rock View Poultry Farm	211	227	211	190	160	144	1,143
C. A. Goos	189	202	143	199	181	199	1,113
Bathurst Poultry Farm	193	196	149	210	178	179	1,105
Arch. Neil	159	195	166	197	197	173	1,087
J. Purnell	185	185	168	178	192	169	1,077
J. W. Short	195	165	183	154	202	159	1,058
Mrs. R. E. Hodge	153	180	178	190	192	162	1,055
J. M. Manson	152	154	180	215	180	170	1,051
H. Fraser	174	155	170	179	187	160	1,025
A. C. G. Wenck	179	169	134	178	150	194	1,004
N. J. Nairn	176	150	184	166	150	166	992
Mrs. E. White	101	156	182	178	158	100	875

EGG-LAYING COMPETITION—*continued.*

DETAILS OF SINGLE HEN PENS—*continued.*

Competitors.	A.	B.	C.	D.	E.	F.	Total.
HEAVY BREEDS.							
R. Burns	236	246	208	189	314	193	1,386
Mrs. A. E. Gallagher	209	230	222	223	216	216	1,316
W. Becker	219	219	229	223	202	192	1,284
Jas. Potter	194	240	206	203	207	229	1,279
Jas. Ferguson	225	234	207	197	186	214	1,263
Mrs. A. Kent	169	220	156	243	179	182	1,149
E. Walters	227	227	175	154	180	183	1,146
T. Hindley	194	202	205	197	180	165	1,143
Parisian Poultry Farm	172	187	183	213	187	186	1,128
Jas. Hutton	213	166	195	198	158	191	1,121
E. F. Dennis	190	202	188	187	143	188	1,098
C. C. Dennis	186	200	136	178	182	174	1,056
H. M. Chaille	164	197	190	169	155	170	1,045
R. Holmes	134	153	168	178	197	207	1,037
J. H. Jones	190	187	172	140	145	185	1,019

J. K. MURRAY, Principal.

N.U.P.B.A. COMPETITION, ZILLMERE.

RESULTS FOR FEBRUARY.

With only one more month to go this competition has reached an interesting stage. For first place a White Leghorn and Black Orpington tied, while in both sections there were several birds with only an egg or two difference. A close finish is almost certain. One thousand nine hundred and twenty-six eggs were laid during the month, an average of $14\frac{3}{4}$ per bird. The following birds are moulting:—22, 31, 35, 68, 74, and broodiness has affected the laying of the following birds during February:—25, 45, 54, 84, 85, 95, 100, 103, 104, 106, 110, 111, 115, 116, 118.

WHITE LEGHORNS.

Pen No.	Owner.	Feb.	Total.
62	Miss L. M. Dingle	23	u281
14	Enroh Pens	24	u273
4	T. H. Craig	23	249
72	W. H. Forsyth	21	248
75	W. Shaffrey	20	u247
28	H. T. Britten	22	246
27	H. T. Britten	20	u245
51	Kidd Bros.	22	244
50	J. Harrington	19	243
13	Enroh Pens	21	241
20	W. Witt	21	241
53	H. Holmes	25	u240
59	G. Scaletti	23	240
16	W. J. Berry	21	u238
41	W. Wakefield	21	238
7	Oakleigh P.F	14	235
43	Kelvin P.F.	20	235
66	R. Duff	12	234
73	A. Hodge	21	233
8	Oakleigh P.F.	21	231
58	H. Fraser	27	u231
15	W. J. Berry	7	u230
30	W. and G. W. Hindes	18	230
33	A. S. Walters	14	230
71	W. H. Forsyth	19	230
49	J. Harrington	17	229
10	R. C. J. Turner	21	u228
78	W. Smith	23	228
2	Carinya P.F.	23	226
3	T. H. Craig	23	224
22	M. F. Newberry	6	224
37	G. Williams	20	220
18	A. W. Ward	13	218
38	G. Williams	20	218
42	W. Wakefield	16	217
54	H. Holmes	13	u216
21	M. F. Newberry	22	216
69	R. Shaw	11	215
48	R. D. Chapman	22	214
61	Miss L. M. Dingle	15	213
70	R. Shaw	15	213
83	L. Andersen	21	213
26	E. Stephenson	19	212
34	A. S. Walters	19	u209
40	J. Earl	18	209
55	G. Baxter	17	209
45	F. R. Koch	20	207
84	L. Andersen	3	207

"u" indicates eggs under 2 oz.

N.U.P.B.A. COMPETITION, ZILLMERE—*continued.*

WHITE LEGHORNS—*continued.*

Pen No.	Owner.	Feb.	Total.	Pen No.	Owner.	Feb.	Total.
36	J. T. Webster	15	206	57	H. Fraser	11	177
77	W. Smith	19	205	63	S. Lloyd	8	u176
74	A. Hodge	4	205	56	G. Baxter	12	172
44	Kelvin P.F.	20	204	25	E. Stephenson ..	10	u170
11	A. Neil	19	201	35	J. T. Webster ..	2	169
47	R. D. Chapman ..	21	199	9	R. S. J. Turner ..	21	u167
52	Kidd Bros.	20	199	17	A. W. Ward	11	165
76	W. Shaffrey	12	199	46	F. R. Koch	15	165
12	A. Neil	16	u197	19	W. Witt	9	164
23	Parisian P.Y. ..	11	197	31	H. Needs	5	164
32	H. Needs	19	195	85	A. Cowley	1	154
5	P. J. Fallon	20	193	82	J. E. G. Purnell ..	9	149
81	J. E. G. Purnell ..	9	193	67	J. and G. Green ..	8	145
39	J. Earl	18	192	68	J. and G. Green ..	0	115
64	S. Lloyd	0	190	60	G. Scaletti	16	113
6	P. J. Fallon	10	186	65	R. Duff (replaced 6th October, 1923) ..	17	101
1	Carinya P.F.	5	185				
29	W. and G. W. Hindes	1	u185	80	W. Bliss	5	69
24	Parisian P.Y.	20	179	86	A. Cowley	0	38
79	W. Bliss	20	179				

BLACK ORPINGTONS.

101	Enroh Pens	21	249	105	W. Smith	9	196
92	J. Pryde	13	u248	120	J. Harrington ..	7	186
109	T. H. Brotherton ..	22	245	108	E. F. Dennis.. ..	13	184
117	E. C. Raymond ..	21	241	98	W. Shaffrey	19	180
95	J. Potter	2	235	116	C. C. Dennis ..	13	179
89	K. Macfarlane ..	23	230	102	Enroh Pens	7	170
93	H. B. Stephens ..	24	u221	104	L. Pritchard ..	7	170
113	E. Walters	23	220	99	S. Donovan ..	18	167
96	J. Potter	16	215	94	H. S. Stephens ..	13	161
115	C. C. Dennis.. ..	13	u215	119	J. Harrington ..	0	146
118	E. C. Raymond ..	15	212	103	L. Pritchard ..	10	144
112	H. M. Chaille ..	14	201	114	E. Walters	16	u141
110	T. H. Brotherton ..	0	200	97	W. Shaffrey	13	136
90	K. Macfarlane ..	14	199	107	E. F. Dennis ..	5	113
87	Parisian P.Y. ..	19	198	100	S. Donovan	4	94
91	J. Pryde	19	u198				

OTHER VARIETIES.

131	W. H. Forsyth (S.W.)	17	236	127	A. S. Walters (B.R.)	8	155
125	J. Ferguson (Lang.)	18	219	128	A. S. Walters (B.R.)	1	155
126	J. Ferguson (Lang.)	13	183	129	R. A. Girling (Min.)	18	147
123	J. Ferguson (Anc.)	18	161	132	W. H. Forsyth (S.W.)	2	u131
122	Parisian P.Y. (B.L.)	13	158	124	J. Ferguson (Anc.)	2	126
130	R. A. Girling (Min.)	18	156	121	Parisian P.Y. (B.L.)	10	u121

"u" indicates eggs under 2 oz.

QUEENSLAND TREES.

No. 29.

By C. T. WHITE, F.L.S., Government Botanist, and W. D. FRANCIS, Assistant Botanist.

The Sour Cherry, *Eugenia corynantha*, is a fairly large tree of the Southern Queensland rain forests. It attains a height of about 110 feet and a barrel diameter of about 2 feet. The bark is grey and in larger trees generally scaly. The wood often splits well and has been used by settlers in constructing the rough buildings which are used in the early stages of land clearing and other initial work. The fruit is deep red in colour, very fleshy, and acid to the taste. They ripen in large numbers and are seen thickly strewn on the ground beneath the trees. They provide food for pigeons and other birds. The species has also been known under the botanical name of Eugenia punctulata, but the one we have used at the beginning of this article is the older name and therefore the valid one. The trees are found as far south as Port Macquarie, New South Wales (F. V. Mueller), and as far north as Gympie.

Photo. by Authors.] PLATE 52.—THE SOUR CHERRY.

Eugenia corynantha on left, the tree on the right hand side of the picture is *Endiandra discolor*. The photo. was taken at Cedar Creek, westward of Eumundi.

Photo: Dept. Agriculture and Stock.

PLATE 53.—THE SOUR CHERRY.

A. Dried herbarium specimen of branchlet bearing flowers, natural size.

B. Fresh branchlet bearing fruit, to scale.

WEEDS OF QUEENSLAND.

By C. T. WHITE, Government Botanist.

No. 36.

BLUE TOP HELIOTROPE (*HELIOTROPIUM ANCHUSAEFOLIUM*).

Description.—A widely spreading more or less procumbent perennial with ascending stems, clothed in all parts with rather long but scattered hairs. Leaves soft with wavy edges, oblong-lanceolate, mostly about 1½ inches long, and about ¼-inch broad. Flowers lilac or blue, with a yellow tube and throat, arranged in forked one-sided spikes, the spikes recurved at the top, from a few lines to 3 inches or even longer, according to age. Fruit consisting of two carpels (seeds),* each carpel or "seed" more or less flattened on the inner side, the outer side rounded, slightly rugose; about 1½ lines long and nearly as broad.

Distribution.—A native of Brazil and the Argentine, South America. In Australia it is a common weed in South-eastern Queensland, and also occurs as a naturalised alien in South Australia (Black, "Naturalised Flora of South Australia.")

Common Names.—Blue Top, Blue Weed, and Wild Heliotrope are names in common use for it in Queensland.

Botanical Name.—*Heliotropium,* from the Greek *helios* the sun, and *trepo* I turn; from the belief that the flowers always turned towards the sun.

Properties.—It is not known to possess any poisonous properties, and I do not know it to have any economic value.

Eradication.—The plant was no doubt introduced as a garden plant and was naturalised on the coastal lands for many years past, but has never given evidence there of being of an aggressive nature. A few years ago it made its appearance on the Darling Downs and a few other places, and has established itself as a very bad weed, most difficult of eradication and rapidly on the increase. The plant is a perennial and makes a long, strong, slender tap root.

In small areas such as gardens and household allotments forking or pulling out of the plant so that the central root is destroyed is the best means of eradication. In larger areas the plants should be hoed off, care being taken to see that the central root is cut well below the surface of the ground.

Where it can be used in safety an arsenical spray might be tried, and as a spray suitable for weed destruction the Agricultural Chemist (Mr. J. C. Brünnich) has recommended the following:—

"Half a pound of arsenic dissolved by means of one-quarter of a pound of caustic soda in three gallons of water, and the solution then diluted to ten gallons with water."

As the plant is a comparatively recent introduction on the Downs and it already shows the power of becoming a bad pest, a lookout should be kept for it and the plants destroyed when they put in an appearance. It can be easily recognised by its blue flowers and typical heliotrope appearance.

Botanical Reference.—*Heliotropium anchusaefolium,* Poiret Suppl. III. 23.

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* What is popularly known as the seed in this plant is really a carpel containing two or sometimes one seed.

PLATE 54.—BLUE TOP HELIOTROPE (*Heliotropium anchusaefolium*).

NOTES ON TWO WEED PESTS.

By C. T. WHITE, Government Botanist.

A NEW WEED AND A WARNING.

Under date 18th February, 1924, Mr. Quigley, of Deuchar, near Warwick, S. W. Railway, writes:—

"There is a creeping plant growing on my property at Deuchar which is giving me quite a lot of trouble in trying to destroy, but without success. It is only a small plot in the centre of a cultivation paddock, about one chain square, and I have ploughed it fully a foot deep with a disc plough, but it makes a fresh growth below where it is cut off. It has been here to my knowledge thirteen years, and strange to say the plot has not got any larger, although it surely must have seeded at some time.

"I am forwarding you a specimen of the plant under separate cover and would ask you to be good enough to let me know the name of the plant, and the best means of destroying same. I might also add I have been on the lookout for years, but have failed to find it growing on any other place. Should you require any further information I will be only too pleased to let you have it.

"Trusting you will oblige."

The weed forwarded by Mr. Quigley is the common Bindweed (*Convolvulus arvensis*), a native of Europe but widely distributed over the temperate regions of the globe. It has not been previously recorded for Queensland, but is a particularly troublesome pest in cultivation areas and very abundant in the Southern States—particularly Victoria—where it causes a lot of trouble by its twining stems curling round the stalks of cultivated plants and practically choking them. It is a perennial with extensive underground creeping stems, often a foot below the surface of the soil and any small part of which is capable of forming a new plant. Small plots can be grubbed out and the underground stems and roots picked out and burnt. Means of spreading is principally by seed. Fortunately, Mr. Quigley's statement that the weed has been on his property for thirteen years without signs of spreading would indicate that the Queensland climate does not suit the plant too well, and possibly this prevents ripe seeds being formed. The plant can be told by its pink (sometimes almost white) small convolvulus flowers and its creeping underground stems.

THE RUBBER VINE.

Writing in the "Peak Downs Telegram," Clermont, of 26th January, under the heading of "A Warning," a correspondent ("Experior") writes:—

"I wish to draw your attention to a certain vine, the rubber plant, which has been declared a noxious weed. This plant contains caustic, which, when the plant is dead, takes the form of powder. This is dangerous, and when the dead vine is broken the powder emerges like a fine dust. This enters the throat, causing violent coughing. A swelling begins each side of the nose, and the eyelids come up in blisters. This powder does not affect all people. The best remedy is to stop the coughing, and apply hot foments to eyes and nose. The plant when green oozes a white sap. I trust this will serve as a useful warning."

The plant referred to is evidently the Rubber Vine (*Cryptostegia grandiflora*), an illustrated article on which appeared in this Journal for April, 1923. It has been declared a weed for the whole State, but as such is restricted to the Central and Northern parts of the State.

I have not previously heard of the plant as an irritant, and would be glad to hear of the experiences of any other people in respect to the plant in this direction. A feature noted by "Experior"—namely, that all people are not affected—is a characteristic of most skin-irritating plants. The vine is a native of Madagascar, but is widely distributed as a cultivated plant over the warmer regions of the globe.

MILKING RECORDS, Q.A.H.S. AND COLLEGE DAIRY HERD, FEBRUARY, 1924.

Name of Cow.	Breed.	Date of Calving.	Total Milk.	Test.	Commercial Butter.	Remarks.
			Lb.	%	Lb.	
College Cobalt ..	Jersey ..	14 Sept., 1923	840	4·6	45·30	
College Wild-flower	,,	13 Aug., 1923	660	5·0	39·00	
Netherton Belle	Ayrshire	30 Oct., 1923	870	3·7	37·50	
Dawn of Warra-gaburra	Jersey ..	10 Nov., 1923	690	4·5	35·60	
College Grandeur	,,	11 July, 1923	540	5·7	36·30	
College Sunrise..	,,	3 Jan., 1924	780	3·8	34·80	
Comedienne ..	,,	10 July, 1923	510	5·7	34·20	
Hedges Nattie ..	Friesian	21 Nov., 1923	720	3·8	32·10	
Miss Fearless ..	Ayrshire	17 Nov., 1923	720	3·8	32·10	
Bellona	,,	3 Aug., 1923	690	3·9	31·20	
Magnet's Leda ..	Jersey ..	18 Aug., 1923	630	4·2	30·90	
Miss Security ..	Ayrshire	8 June, 1923	800	3·3	30·80	
Hedges Madge ..	Friesian	18 Aug., 1923	720	3·6	30·00	
College Promise	Jersey ..	14 Aug., 1923	570	4·4	29·40	
Miss Betty ..	,,	30 Oct., 1923	630	4·0	29·40	
Fair Lassie ..	Ayrshire	28 Nov., 1923	630	3·8	28·20	
Songstress ..	,,	22 Aug., 1923	600	4·0	27·90	
Buttercup ..	Shorthorn	7 Sept., 1923	750	3·2	27·90	
Dear Lassie ..	Ayrshire	1 Nov., 1923	600	3·9	27·30	
College Hope ..	Jersey ..	21 Oct., 1923	480	4·8	27·00	
College Meadow Queen	Friesian	10 Jan., 1924	720	3·2	26·70	
Guid Lassie ..	Ayrshire	— Jan., 1924	600	3·8	26·70	
Yarraview Snow-drop	Guernsey	7 Sept., 1923	480	4·7	26·40	
College Ma Petite	Jersey ..	12 June, 1923	510	4·4	23·10	
College Desire ..	Ayrshire	11 July, 1923	480	4·2	23·70	
Confidante ..	,,	7 Sept., 1923	600	3·4	23·70	
College St. Martha	Jersey ..	25 June, 1923	390	5·0	22·80	
Mistress May ..	Ayrshire	20 June, 1923	480	4·0	22·20	
Lady Meg ..	,, ..	14 July, 1923	600	3·8	21·70	
College La Cigale	Jersey ..	25 June, 1923	360	5·1	21·60	
Gay Lassie ..	Ayrshire	5 July, 1923	420	4·2	20·70	
Miss Faithful ..	,,	— Jan., 1924	450	3·8	20·10	

NATURAL METHOD OF INSECT CONTROL.

Some time since the Entomologist stationed at Stanthorpe, Mr. H. Jarvis, introduced into the Stanthorpe area an hymenopterous parasite of the notorious fruit fly—a Braconid named *Opius tryoni*, Cameron, in honour of its discoverer—and the plan of campaign there embraces a full exploitation of this method of natural control by the aid of supplementary enemies, yielded by other hymenopteræ known to us.

In addition to the fruit fly, *Chætodacus tryoni*, there are other redoubtable insect pests occurring in the district, notably the Woolly Aphis of the apple, *Schizoneura lanigera*.

In order to cope with this, by the natural method of control also, a small chalcidid wasp named *Aphelinus mali*, a formidable enemy to this so-called American blight insect, was introduced into the Granite Belt area in September, 1923.

This was mentioned by Mr. Jarvis in his latest periodical report—December, 1923—January, 1924, inclusive—wherein he writes as follows:—

"The Woolly Aphis parasite, *Aphelinus mali*, Hald., imported from New Zealand 14th August, 1923, by courtesy of Dr. R. J. Tillyard, M.A., D.Sc., &c., will, I hope, become established in this district. One hundred and seven examples of this parasite were bred from the material sent me by Dr. Tillyard. These were liberated in three

trees infested with Woolly Aphis; the last date on which parasites were liberated was on 28th September, 1923. From time to time the trees on which parasites had been liberated were examined, but nothing was seen of them until 20th January, 1924. On that date a large number of Woolly Aphis were discovered showing the characteristic hole made by the parasite in emerging.

''Very many of these parasites must then have already hatched out and dispersed about the orchards in the Stanthorpe area, in which the majority of the first brood were liberated.

''On carefully examining the apple trees in this orchard little or no Woolly Aphis was visible, so that my only fear is that the parasite may not (from lack of its host) continue to multiply.

''Only one individual *Aphclinus* was recovered from twigs (bearing a few Aphids) taken from the tree on which they were first liberated and kept under conditions to admit of the obtainment of any specimens on issuing. Additional specimens will, I hope, hatch out in order to provide sufficient material to carry over the winter for use in distribution next spring.

''Application has been made to Dr. Tillyard for an additional supply of the parasite to ensure its successful establishment in this district as a permanent useful endowment.'' (H. Jarvis' Report, December, 1923—January, 1924.)

The question of the permanent establishment of this useful insect (*Aphelinus mali*) in the Stanthorpe district as a powerful control of the apple pest referred to, being thus still an open one, the Assistant Entomologist, Mr. A. A. Girault (one of the foremost authorities on chalcidid insects in the world, as indicated by his voluminous writings on the subject), who happened to be sojourning in Stanthorpe on private business, was instructed to pursue investigations there, that it might be finally settled.

And already he reports that this useful insect is still living at large near where liberated. ''Instructions,'' he writes, ''were carried out at Stanthorpe on 18th March; the parasite was located alive in two places in the original orchard,'' where its establishment, as a basis for further distribution, had been effected.''

FORTHCOMING SHOWS.

The Queensland Chamber of Agricultural Societies has supplied the following list of show dates for 1924:—

Wallumbilla: 15th and 16th April.
Clifton: 16th and 17th April.
Herberton, 21st and 22nd April.
Oakey: 24th April.
Maleny: 23rd and 24th April.
Goondiwindi: 29th and 30th April.
Blackall: 6th and 7th May.
Charleville: 6th and 7th May.
Taroom: 6th and 7th May.
Toogoolawah: 7th and 8th May.
Wondai: 8th and 9th May.
Boonah: 14th and 15th May.
Springsure: 14th and 15th May.
Murgon: 15th and 16th May.
Roma: 20th and 21st May.
Kilkivan: 21st and 22nd May.
Ipswich: 21st to 23rd May.
Emerald: 21st and 22nd May.
Beaudesert: 28th and 29th May.
Gayndah: 28th to 31st May.
Marburg: 2nd and 3rd June.
Hughenden: 3rd and 4th June.
Esk: 4th and 5th June.
Maryborough: 3rd to 6th June.
Childers: 10th and 11th June.
Bundaberg: 12th to 14th June.
Pine Rivers: 13th and 14th June.
Gin Gin: 16th and 18th June.
Woombye: 18th and 19th June.
Gladstone: 19th and 20th June.
Lowood: 20th and 21st June.
Mount Larcom: 21st June.
Rockhampton: 24th, 26th, 27th, and 28th June.
Mackay: 3rd to 5th July.
Kilcoy: 3rd and 4th July.
Biggenden: 3rd and 4th July.
Wallumbilla: 8th and 9th July.
Bowen: 9th and 10th July.
Laidley: 9th and 10th July.
Woodford: 10th and 11th July.
Gatton: 16th and 17th July.
Townsville: 16th and 17th July.
Caboolture: 17th and 18th July.
Sunnybank: 19th July.
Barcaldine: 22nd and 23rd July.
Charters Towers: 23rd and 24th July.
Rosewood: 23rd and 24th July.
Ithaca: 25th and 26th July.
Nambour: 30th and 31st July.
Ayr: 1st and 2nd August.
Mount Gravatt: 2nd August.
Humpybong: 7th August.
Royal National: 11th to 16th August.
Gympie: 20th and 21st August.
Belmont: 23rd August.
Imbil: 27th and 28th August.
Coorparoo: 30th August.
Crow's Nest: 4th September.
Wynnum: 6th September.
Beenleigh: 11th and 12th September.
Zillmere: 13th September.
Stephens: 20th September.
Rocklea: 27th September.
Kenilworth: 2nd October.
Toombul: 3rd and 4th October.
Southport: 10th October.

IRRIGATION IN QUEENSLAND—IX.

H. E. A. EKLUND, late Hydraulic Engineer, Queensland Water Supply Department.

The following tables and appendices are supplementary to Mr. Eklund's recently concluded series on Irrigation in Queensland.

TABLE I.

Barometric Pressure at Different Altitudes with Equivalent Head of Water and Suction Lift of Pumps.

Altitude.	Barometric Pressure. Lbs per square in.	Equivalent Head of Water.	Maximum Practical Suction Lift.
		Feet.	Feet.
Sea level	14·70	33·95	22·0
¼ mile—1,320 feet above sea level	14·02	32·38	21·0
½ mile—2,640 feet above sea level	13·33	30·79	20·0
¾ mile—3,960 feet above sea level	12·66	29·24	18·5
1 mile—5,280 feet above sea level	12·02	27·76	17·6
1¼ mile—6,600 feet above sea level	11·42	26·38	16·7

TABLE II.

Area Cropped.

Year.	Sugar.	Maize.	Wheat.
	Acres.	Acres.	Acres.
1906	133,284	139,806	114,575
1907	126,810	127,119	82,416
1908	123,902	127,655	80,898
1909	128,178	132,313	117,160
1910	141,779	180,862	106,718
1911	130,376	153,916	42,962
1912	141,652	117,993	124,963
1913	147,743	156,775	132,655
1914	161,195	176,372	127,015
1915	153,027	146,474	93,703

—From the Government Statistician's Report.

TABLE III.

Year.	Sugar.	Maize.	Wheat.
	Tons.	Bushels.	Bushels.
1906	17·61	26·49	9·68
1907	17·64	24·34	8·41
1908	15·54	21·68	14·87
1909	14·53	18·96	13·41
1910	19·45	24·66	9·58
1911	16·02	23·63	6·64
1912	12·72	21·39	15·81
1913	20·29	24·97	13·34
1914	17·80	24·16	12·48
1915	12·20	13·68	4·43

—From the Government Statistician's Report.

TABLE III.—SHOWING AREAS ACTUALLY IRRIGATED IN QUEENSLAND EACH YEAR DURING THE LAST QUARTER CENTURY. (FROM STATISTICAL RECORDS.)

District.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Adavale	..	..	..	..	..	6	3	..
Allora	..	..	..	..	..	..	..	..
Aramac	..	..	..	..	..	..	..	..
Arillalah	8	..	..	..	..	..	..	..
Augathella	..	..	..	..	..	..	4	..
Ayr	3,674	3,020	3,875	4,262	4,975	5,078	5,165	7,402
Banana	..	..	..	1	..	2	2	..
Barcaldine	..	..	61½	87	58	137	172	205
Beaudesert	..	..	..	..	..	..	..	..
Biggenden	..	..	..	..	..	..	..	..
Blackall	..	..	..	38	7	66	57	103
Bollon	..	..	..	..	..	..	..	..
Bowen	30	60	139½	95	30	146	138	63
Brisbane	4¾	..	22¼	6	20	11	62	63
Bundaberg	..	..	..	..	..	..	..	..
Burke	..	..	..	15	7	..	..	..
Burketown	..	..	..	..	..	..	..	6
Caboolture	10	..	..	..	..	..	..	..
Cairns	2	..	..	10	3	3	..	..
Camooweal	..	..	..	..	..	..	..	..
Cape River	..	..	16	24	27	16	22	22
Charleville	..	..	9	7	..	12	22	50
Charters Towers	..	..	15½	..	..	17	16	20
Clermont	..	..	..	4	..	..	..	7
Cleveland	..	..	6	9	7	4	4	6
Clifton	..	..	..	..	..	..	..	..
Cloncurry	..	..	..	..	..	..	29	..
Cook	..	..	..	3	7	4	3	10
Croydon	..	46	..	41	29	11	10	14
Cunnamulla	..	..	5	..	8	29	40	2
Dalby	..	..	..	..	..	..	..	..
Diamantina	3	3	..	..	..	..	..	..
Douglas	..	..	3	..	..	..	..	20
Dugandan	..	..	..	..	..	..	..	..
Emerald	..	..	..	..	..	..	10	10
Esk	110	..	..	30	20	25	91	225
Etheridge	1½	1½	7	25	13	13	10	4
Gatton	71	..	55	40	..	..	4	..
Gayndah	..	..	..	..	..	..	..	..
Gin Gin	..	..	..	2	..	..	3	2
Goondiwindi	..	..	..	..	..	..	..	..
Gympie	..	..	..	..	..	..	..	..
Harrisville	..	..	..	20	100	..	..	..
Herberton	..	5	1	4	4	12	6	5
Highfields	..	..	..	..	..	..	..	..
Hughenden	3½	7	..	44	4	89	114	132
Hungerford	..	..	..	..	..	..	..	13
Ingham	..	..	..	..	..	..	..	2
Inglewood	..	..	..	1	..	..	..	..
Ipswich	..	..	..	..	..	..	..	..
Isisford	..	..	11	19	13	11	14	7
Jondaryan	..	..	..	..	..	..	..	..
Killarney	..	..	..	..	..	..	..	..
Laidley	..	..	..	..	50	..	..	..
Leyburn	130	..	..	..	..	..	..	..
Logan	20½	5	..	..	5	..	..	..
Longreach	..	..	1½	11	..	20	4	1
Mackay	189	299	292	510	451	182	102	13
Maroochy	..	..	..	..	..	..	2	..
Maryborough	..	..	7	..	5	..	..	..
Mitchell	..	..	..	..	12	..	..	..
Mourilyan	186	..	..	..	..	..	..	..
Muttaburra	..	..	9	11	9	11	11	26
Nanango	..	..	..	..	..	..	..	..
Nerang	..	..	..	..	..	..	..	..
Norman	18	..	..	13	8	17	19	..
Normanton	..	18	..	..	..	..	..	..
Palmer	..	..	..	..	..	..	..	..
Ravenswood	..	..	..	..	..	5	4	8
Redcliffe	..	..	..	..	..	..	..	..
Richmond	..	..	..	..	..	..	..	..
Rockhampton	..	6	170¼	44	39	70	65	738
Roma	..	..	..	..	..	..	10	21
Rosewood	..	..	..	..	..	..	..	..
Somerset	..	..	..	..	..	..	..	..
Springsure	..	..	..	..	3	2	4	2
Stanthorpe	25	37	50	70	3	116	45	8
St. George	4	5	11	18	23	42	50	45
Surat	..	..	..	..	..	..	..	25
Tambo	..	..	1½	..	..	3	15	9
Tara	3	..	..	..	..	..	..	..
Taroom	..	..	..	..	..	..	5	3
Texas	..	..	..	..	..	..	..	..
Thargomindah	..	..	..	..	..	11	12	17
Thornborough	3	2	1½	1	2	..	2	3
Tiaro	..	4	31½	2	..	2	..	..
Toowoomba	..	85	102½	92	275	137	143	125
Townsville	..	183½	329½	186	239	2,058*	149	151
Warwick	..	51	51	..	..	..	..	..
Windorah	..	..	2	4	..	..	4	..
Woodford	..	..	..	25	..	..	..	..
Other Districts	..	..	..	72	..	..	..	..
Grand Totals	3,896¼	3,838	5,286¾	5,846	6,456	8,368	6,647	9,588

* This appears to be an error in the statistical compilation.

TABLE III SHOWING AREAS ACTUALLY IRRIGATED IN QUEENSLAND EACH YEAR DURING THE LAST QUARTER CENTURY. (FROM STATISTICAL RECORDS.)—*continued.*

District.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres
Adavale	..	..	..	3	..	..	..	..	..
Allora	..	..	..	171	100	..	120	72	82
Aramac	..	6	4	17	18	..	..	..	..
Arillalah ..	..	..	..	..	..	..	..	..	..
Augathella ..	..	..	..	..	..	..	..	..	..
Ayr	4,825	4,726	3,896	4,070	3,622	4,334	4,678	4,978	4,492
Banana	..	1	1	2	..	..	..	..	..
Barcaldine ..	195	683	462	772	855	285	278	120	100
Beaudesert ..	..	..	..	4	20	..	..	..	..
Biggenden ..	..	..	..	1	..	..	..	..	..
Blackall	119	40	28	18	29	..	..	..	..
Bollon	..	21	9	8	..	..	..	..	..
Bowen	109	126	162	201	286	265	278	295	356
Brisbane ..	51	45	14	56	68	64	66	64	15
Bundaberg ..	..	150	210	*2,906	4,410	5,848	5,858	2,526	2,350
Burke	..	9	13	13	13	..	..	..	..
Burketown ..	..	..	..	..	..	..	..	..	..
Caboolture ..	..	..	..	1	..	..	..	..	..
Cairns	..	13	11	11	69	..	..	..	..
Camooweal ..	..	..	..	1	..	..	..	..	..
Cape River ..	23	49	39	18	21	..	..	..	..
Charleville ..	35	16	18	17	18	..	..	..	..
Charters Towers	28	33	47	25	31	..	58	61	60
Clermont.. ..	14	5	5	4	..	..	..	..	..
Cleveland ..	5	4	8	16	10	..	..	..	..
Clifton	..	..	..	..	..	..	..	..	..
Cloncurry ..	12	14	14	..	..	..	..	..	..
Cook	45	6	15	11	39	..	..	..	..
Croydon	24	..	..	..	..	..	..	..	..
Cunnamulla ..	126	30	263	†3,200	2,760	120	55	55	51
Dalby	..	..	..	2	..	..	..	..	..
Diamantina ..	..	..	..	..	..	..	..	..	..
Douglas	..	..	..	..	..	..	..	..	..
Dugandan ..	..	..	13	10	..	..	..	..	..
Emerald	7	9	16	16	38	..	..	..	..
Esk	..	..	2	45	37	..	..	..	..
Etheridge ..	6	3	5	8	..	..	..	..	..
Gatton	4	..	..	174	25	92	203	14	53
Gayndah ..	..	..	..	1	..	..	..	..	..
Gin Gin	..	..	..	6	..	..	..	..	..
Goondiwindi ..	..	..	..	..	..	..	..	..	..
Gympie	14	42	48	25	21	..	..	..	..
Harrisville ..	..	..	..	59	..	..	..	..	50
Herberton ..	7	4	17	..	..	..	..	..	..
Highfields ..	..	..	..	5	..	..	..	..	..
Hughenden ..	151	143	156	54	39	..	..	..	..
Hungerford ..	21	56	115	136	153	98	70	120	240
Ingham	2	5	80	70	70	170	206	21	28
Inglewood ..	..	..	..	..	30	..	..	..	..
Ipswich	..	10	10	44	47	..	..	..	..
Isisford	6	4	2	1	..	..	..	..	..
Jondaryan ..	..	..	..	..	..	..	..	..	..
Killarney ..	..	..	..	29	..	..	..	..	..
Laidley	..	..	..	..	25	..	50	15	..
Leyburn	..	..	..	..	..	..	..	..	..
Logan	..	..	..	..	..	..	..	..	..
Longreach ..	17	..	8	5	30	..	..	..	..
Mackay	93	229	304	496	514	542	125	127	20
Maroochy ..	2	1	..	..	15	..	..	..	..
Maryborough ..	..	..	..	66	65	50	47	46	39
Mitchell	..	..	..	..	..	..	..	..	..
Mourilyan ..	..	..	..	..	..	..	..	..	..
Muttaburra ..	23	30	29	31	85	..	..	..	..
Nanango ..	..	..	..	2	..	..	..	..	..
Nerang	..	30	..	29	21	..	..	..	..
Norman	..	..	40	40	10	..	..	..	..
Normanton ..	..	..	..	..	..	..	..	..	..
Palmer	3	..	..	..	..	..	..	..	..
Ravenswood ..	6	4	4	5	..	..	..	..	..
Redcliffe ..	..	..	..	25	20	..	..	..	..
Richmond ..	..	..	..	..	..	..	..	..	..
Rockhampton ..	104	86	75	769	675	419	400	383	482
Roma	22	28	30	34	16	..	..	..	..
Rosewood ..	..	..	..	23	..	..	..	..	..
Somerset ..	2	..	..	..	..	..	..	..	..
Springsure ..	..	..	..	..	..	..	..	..	..
Stanthorpe ..	13	12	36	27	25	..	..	..	..
St. George ..	31	27	44	46	40	..	..	..	..
Surat	12	..	1	..	..	..	..	..	..
Tambo	..	..	..	..	..	..	..	..	..
Tara	..	..	..	..	..	..	..	..	..
Taroom	6	2	2	2	..	..	..	..	..
Texas	..	..	..	..	..	..	..	..	..
Thargomindah ..	15	3	1	1	..	..	..	..	..
Thornborough ..	2	..	..	..	..	..	..	..	..
Tiaro	6	6	2	..	..	..	..	..	..
Toowoomba ..	..	..	15	168	..	..	..	..	124
Townsville ..	123	255	235	273	323	365	395	390	306
Warwick ..	..	..	..	10	..	..	94	99	190
Windorah ..	..	3	..	..	..	..	..	..	..
Woodford ..	..	..	..	18	..	..	..	..	..
Other Districts ..	..	..	..	..	83	708	716	536	574
Grand Totals	6,311	6,969	6,526	14,344	14,786	13,360	13,693	9,922	9,612

* First year of operation of the large Bingera plant, described elsewhere.

† Hardly irrigation proper, as this appears to be a rough flooding of the plains, for grasses.

TABLE III.—SHOWING AREAS ACTUALLY IRRIGATED IN QUEENSLAND EACH YEAR DURING THE LAST QUARTER CENTURY. (FROM STATISTICAL RECORDS.)—*continued.*

District.	1908.	1909.	1910.	1911.	1912.	1913.	1914.	1915.	1916.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Adavale	..	..	..	..	..	..	..	..	..
Allora	89	32	101	110	82	54	..	59	..
Aramac	..	..	..	..	..	..	..	..	..
Arillalah ..	..	..	..	..	..	..	..	..	..
Augathella ..	..	..	..	..	..	..	..	..	..
Ayr	4,574	5,547	5,150	3,758	5,590	7,417	7,655	7,898	7,175
Banana	..	..	..	..	..	..	..	..	..
Barcaldine ..	46	33	..	..	..	..	..	..	..
Beaudesert ..	..	..	..	..	..	..	..	..	..
Biggenden ..	..	..	..	..	..	..	..	..	..
Blackall	..	..	..	..	..	..	..	..	..
Bollon	..	..	..	..	..	..	..	..	..
Bowen	385	430	398	556	670	645	589	492	525
Brisbane ..	28	65	62	61	110	89	114	142	144
Bundaberg ..	811	256	203	2,103	206	193	114	195	264
Burke	..	..	..	..	..	..	..	..	..
Burketown ..	..	..	..	..	..	..	..	..	..
Caboolture ..	..	..	..	..	..	..	..	..	..
Cairns	..	..	..	..	..	..	..	..	..
Camooweal ..	..	..	..	..	..	..	..	..	..
Cape River ..	..	..	..	..	..	..	..	..	36
Charleville ..	..	..	..	..	..	..	..	..	..
Charters Towers	51	45	48	69	73	61	66	61	56
Clermont.. ..	..	..	..	..	..	..	..	..	..
Cleveland ..	..	..	..	..	..	..	..	..	..
Clifton	..	..	40	47	113	135	46	83	..
Cloncurry ..	..	..	43	40	34	..	47	44	..
Cook	..	..	..	..	..	..	..	..	..
Croydon	..	..	..	..	..	..	..	..	..
Cunnamulla ..	175	184	176	38	123	496	568	435	420
Dalby	..	..	..	..	..	..	..	..	..
Diamantina ..	..	..	..	..	..	..	..	..	..
Douglas	..	..	..	..	..	..	..	..	..
Dugandan ..	..	..	..	..	..	..	..	..	..
Emerald	..	..	..	..	..	..	..	..	..
Esk	..	..	..	..	67	..	..	52	36
Etheridge ..	..	..	..	..	..	..	..	..	..
Gatton	19	44	..	..	..	..	..	..	..
Gayndah ..	..	..	..	..	..	..	..	..	..
Gin Gin	..	..	..	..	..	..	..	..	..
Goondiwindi ..	..	..	..	..	47	40	..	..	..
Gympie	..	..	..	..	..	..	..	..	..
Harrisville ..	40	101	50	74	82	87	60	147	37
Herberton ..	..	..	..	35	57	44	..	..	..
Highfields ..	..	..	..	..	..	..	..	..	..
Hughenden ..	64	64	61	61	61	60	65	60	60
Hungerford ..	240	240	250	250	250	250	250	..	..
Ingham	..	..	..	..	..	90	90	38	36
Inglewood ..	..	..	37	..	..	70	67	43	60
Ipswich	..	..	..	..	..	..	..	..	..
Isisford	..	..	..	..	..	..	..	..	..
Jondaryan ..	..	..	63	..	..	..	..	..	..
Killarney ..	..	..	..	..	..	..	..	47	50
Laidley	..	..	..	..	..	..	..	..	..
Leyburn	..	..	..	..	..	..	..	..	..
Logan	..	..	..	..	..	..	..	..	..
Longreach ..	31	28	..	..	..	..	..	..	..
Mackay	22	18	..	35	45	47	58	44	..
Maroochy ..	..	..	..	..	..	..	..	..	..
Maryborough ..	46	40	41	47	..	..	..	..	30
Mitchell	..	..	..	..	..	..	..	..	..
Mourilyan ..	..	..	..	..	..	..	..	..	..
Muttaburra ..	..	..	..	..	..	..	..	..	..
Nanango ..	..	..	..	..	..	..	..	..	..
Nerang	..	..	..	..	..	..	..	..	48
Norman	..	..	..	..	..	..	..	..	..
Normanton ..	..	..	..	..	..	..	..	..	..
Palmer	..	..	..	..	..	..	..	..	..
Ravenswood ..	..	..	..	..	..	..	..	..	..
Redcliffe ..	..	..	..	..	..	..	..	41	57
Richmond ..	..	..	31	40	40	40	..	..	..
Rockhampton ..	532	218	201	231	485	509	320	464	498
Roma	..	..	..	..	..	..	50	..	..
Rosewood ..	..	..	..	..	..	..	..	..	..
Somerset ..	..	..	..	..	..	..	..	..	..
Springsure ..	..	..	..	..	..	..	..	..	..
Stanthorpe ..	..	..	55	90	70	67	80	65	30
St. George ..	40	43	51	48	43	47	..	..	39
Surat	..	..	..	..	..	..	..	..	..
Tambo	..	..	..	..	..	..	..	..	..
Tara	..	..	..	..	..	..	..	..	..
Taroom	..	..	..	..	..	..	..	..	..
Texas	..	..	..	..	55	79	57	..	..
Thargomindah ..	..	..	..	..	..	..	..	..	..
Thornborough ..	..	..	..	..	..	..	..	..	..
Tiaro	..	..	..	..	..	..	..	..	..
Toowoomba ..	14	20	30	..	..	43	92	90	89
Townsville ..	309	361	356	332	396	487	477	473	421
Warwick ..	231	160	34	180	113	104	111	106	146
Windorah ..	..	..	..	..	..	..	..	..	..
Woodford ..	..	..	..	..	..	..	..	..	..
Other Districts ..	500	541	525	456	608	702	833	763	629
Grand Totals	8,247	8,470	8,006	8,661	9,420	11,856	11,809	11,842	12,402

TABLE IV.

PUMPING CAPACITY OF WINDMILLS.

CYLINDER AND LENGTH OF STROKE BASED ON A WIND VELOCITY OF 10 MILES PER HOUR.

Diameter of Wheel.	Length of Stroke.	Diameter of Cylinder.	R.P.M.	Gallons per Hour.	Diameter of Cylinder.	R.P.M.	Gallons. per Hour.
		25 FEET ELEVATION.			50 FEET ELEVATION.		
	Inch.	Inch.			Inch.		
8 feet	6	4	40	651	3	40	367
8 feet	8	3½	40	665	2½	40	340
10 feet	6	5	35	892	4	35	570
10 feet	8	4½	35	964	3½	35	582
12 feet	8	6	30	1,467	5	30	1,020
12 feet	10	6	30	1,850	4¾	30	1,140
12 feet	12	6	30	2,200	4½	30	1,230
14 feet	10	6	25	1,530	5¾	25	1,400
14 feet	12	6	25	1,850	5	25	1,270
16 feet	12	8	20	2,610	8	20	2,610
16 feet	16	8¾	20	4,160	7¾	20	3,260
		75 FEET ELEVATION.			100 FEET ELEVATION.		
8 feet	6	2½	40	255	2¼	36	187
8 feet	8	2¼	40	275	2	36	198
10 feet	6	3½	35	485	3¼	32	342
10 feet	8	3	35	428	2¾	32	328
12 feet	8	4½	30	825	3½	27·5	455
12 feet	10	4	30	809	3½	27·5	570
12 feet	12	4	30	940	3¼	27·5	589
14 feet	10	4½	25	863	4	22·5	620
14 feet	12	4	25	809	3½	22·5	569
16 feet	12	6	20	1,570	6	20	1,570
16 feet	16	6	20	1,890	5	18	1,240
		125 FEET ELEVATION.			150 FEET ELEVATION.		
8 feet	6	2	36	149	..	..	..
8 feet	8	..	..	..	..	..	..
10 feet	6	2¾	32	245	2½	32	203
10 feet	8	2¼	32	219	2	32	173
12 feet	8	3½	27·5	455	3¼	27·5	392
12 feet	10	3¼	27·5	491	3	27·5	418
12 feet	12	2¾	27·5	422	2½	27·5	348
14 feet	10	3½	22·5	475	3¼	22·5	408
14 feet	12	3¾	22·5	490	3	22·5	418
16 feet	12	5	20	1,060	5	20	1,060
16 feet	16	4½	18	1,000	4¼	18	896
		175 FEET ELEVATION.			225 FEET ELEVATION.		
8 feet	6	..	..	..	..	..	..
8 feet	8	..	..	..	..	..	..
10 feet	6	2	32	130	..	..	..
10 feet	8	..	..	..	..	..	..
12 feet	8	3	27·5	335	2½	27·5	..
12 feet	10	2¾	27·5	351	2¼	27·5	..
12 feet	12	2½	27·5	348	2	27·5	..
14 feet	10	3	22·5	348	2¾	22·5	..
14 feet	12	2¾	22·5	351	2½	22·5	..
16 feet	12	4½	18	753	4	18	595
16 feet	16	4	18	795	3½	18	607

This Table, based on practice, is made to show that the larger mill does not necessarily raise a greater quantity of water, unless both stroke and diameter of cylinder are correctly proportioned to do the maximum amount of work. In fact, owing to the lower angular velocity of the larger mills, with the same size pump, a small mill will raise more water at low heads than large mills.

TABLE V.

METEOROLOGICAL OBSERVATIONS AT BRISBANE OBSERVATORY OF WIND VELOCITIES IN MILES PER HOUR.

Month.	9 a.m.	3 p.m.	9 p.m.	Average.
1914—				
January	4·7	10·3	4·9	6·6
February	7·7	12·1	6·1	8·6
March	4·2	7·9	3·2	5·1
April	2·7	5·6	2·2	3·5
May	4·4	6·2	2·3	4·3
June	5·7	6·0	3·6	5·1
July	4·4	5·7	2·2	4·1
August	5·1	7·1	3·3	5·1
September	3·5	7·6	3·5	4·8
October	5·0	8·5	4·6	6·0
November	4·0	9·3	5·6	6·3
December	2·6	6·7	4·8	4·0
Average for year	4·5	7·7	3·9	5·3
1915—				
January	3·3	7·8	3·8	4·9
February	3·8	7·7	5·0	5·5
March	2·3	7·4	3·9	4·5
April	1·8	5·8	2·8	3·5
May	1·5	4·0	3·2	2·9
June	2·1	5·7	3·7	3·6
July	1·1	2·9	3·0	3·3
August	1·4	5·3	3·6	3·4
September	2·9	8·6	3·6	5·0
October	5·2	7·4	4·6	5·7
November	4·9	11·8	5·5	7·4
December	7·3	11·5	5·7	8·2
Average for year	3·1	7·1	4·1	4·8
1916—				
January	5·3	11·8	5·8	7·6
February	5·3	9·4	5·5	6·7
March	4·4	9·1	4·3	5·9
April	4·5	6·2	3·7	4·8
May	5·0	6·6	2·4	4·7
June	4·9	6·7	3·2	4·9
July	4·7	5·7	3·2	4·5
August	4·9	7·7	3·4	5·3
September	4·4	8·3	3·3	5·3
October	5·0	8·0	4·2	5·7
November	5·1	9·7	5·2	6·6
December	6·8	9·9	4·0	7·0
Average for year	5·0	8·2	4·0	5·8
1917—				
January	5·0	9·6	3·4	..
February	6·3	9·2	4·4	..
March	5·5	8·0	3·6	..
April	5·2	6·7	3·8	..

TABLE VI.

FRICTION OF WATER IN PIPES PER 100 FEET LENGTH.

Velocity of Water in Feet per Second.	Head in Feet to Produce this Velocity.	INTERNAL DIAMETER OF PIPE IN INCHES.					
		Head to Overcome Friction.	Gallons per Minute.	Head to Overcome Friction.	Gallons per Minute.	Head to Overcome Friction.	Gallons per Minute.
		3-inch.		4-inch.		5-inch.	
1·0	·016	·215	18·3	·150	32·4	·114	50·5
2·0	·062	·786	36·7	·548	64·8	·415	101
2·2	·075	·939	40·4	·656	71·7	·496	112
2·4	·090	1·11	44·1	·771	78	·583	122
2·6	·105	1·28	44·7	·896	84·8	·678	132
2·8	·122	1·47	52·4	1·03	91·1	·778	142
3·0	·140	1·68	55·0	1·17	97·9	·886	152
3·2	·160	1·89	58·7	1·32	104	·999	163
3·4	·180	2·12	62·4	1·48	111	1·12	173
3·6	·202	2·36	66·1	1·65	117	1·25	183
3·8	·225	2·61	69·8	1·82	124	1·38	193
4·0	·250	2·87	73·6	2·01	130	1·52	204
4·2	·275	3·15	76·7	2·20	137	1·66	214
4·4	·302	3·43	80·4	2·40	143	1·81	224
4·6	·330	3·73	84·2	2·60	149	1·97	234
4·8	·360	4·04	87·9	2·82	156	2·13	244
5·0	·390	4·36	91·7	3·04	163	2·30	254
5·2	·422	4·69	95·4	3·27	169	2·48	265
5·4	·455	5·03	99·2	3·51	175	2·66	275
5·6	·490	5·39	102	3·76	182	2·85	285
5·8	·525	5·75	106	4·02	189	3·04	295
6·0	·562	6·13	110	4·28	195	3·24	305
6·2	·600	6·52	113	4·55	202	3·44	316
6·4	·640	6·92	117	4·83	209	3·65	326
6·6	·680	7·33	121	5·11	215	3·87	336
6·8	·722	7·75	124	5·41	222	4·09	346
7·0	·765	8·18	128	5·71	228	4·32	356
		6-inch.		7-inch.		8-inch.	
1·0	·016	·090	73	·075	99·5	·063	130·5
2·0	·062	·330	146	·273	199	·231	261
2·2	·075	·395	161	·326	220	·276	287
2·4	·090	·465	175	·383	240	·324	313
2·6	·105	·540	190	·445	260	·377	339
2·8	·122	·620	205	·511	280	·433	365
3·0	·140	·705	220	·582	300	·492	391
3·2	·160	·796	235	·656	320	·555	418
3·4	·180	·891	249	·735	340	·622	444
3·6	·202	·992	264	·818	360	·692	470
3·8	·225	1·10	278	·905	380	·766	496
4·0	·250	1·21	293	·998	399	·845	522
4·2	·275	1·32	308	1·09	419	·924	548
4·4	·302	1·44	313	1·19	439	1·01	574
4·6	·330	1·57	337	1·29	459	1·10	600
4·8	·360	1·70	352	1·40	479	1·19	624
5·0	·390	1·83	367	1·51	499	1·28	655
5·2	·422	1·97	381	1·63	519	1·37	680
5·4	·455	2·12	396	1·75	540	1·47	705
5·6	·490	2·27	411	1·87	560	1·58	730
5·8	·525	2·42	426	2·00	580	1·69	755
6·0	·562	2·58	441	2·13	600	1·80	780
6·2	·600	2·74	455	2·26	620	1·91	811
6·4	·640	2·91	470	2·40	641	2·03	836
6·6	·680	3·08	484	2·54	661	2·15	861
6·8	·722	3·26	499	2·69	681	2·27	886
7·0	·765	3·44	514	2·84	701	2·40	911
		9-inch.		10-inch.		11-inch.	
1·0	·016	·055	165	·048	204	·042	247
2·0	·062	·199	330	·174	408	·155	494
2·2	·075	·238	363	·208	449	·185	543
2·4	·090	·280	396	·245	489	·218	592
2·6	·105	·325	429	·285	530	·253	641
2·8	·122	·373	463	·327	571	·291	690
3·0	·140	·425	496	·372	612	·331	740
3·2	·160	·479	529	·420	653	·373	789
3·4	·180	·537	562	·471	693	·418	838
3·6	·202	·597	595	·524	734	·465	887
3·8	·225	·661	630	·580	775	·515	937
4·0	·250	·729	661	·639	817	·567	987
4·2	·275	·797	692	·699	857	·620	1,036
4·4	·302	·870	723	·762	897	·676	1,085
4·6	·330	·945	761	·828	938	·735	1,134
4·8	·360	1·02	792	·897	979	·796	1,184
5·0	·390	1·10	823	·968	1,019	·859	1,234
5·2	·422	1·19	861	1·04	1,060	·925	1,283
5·4	·455	1·28	892	1·12	1,111	·993	1,332
5·6	·490	1·37	923	1·20	1,142	1·063	1,381
5·8	·525	1·46	960	1·28	1,183	1·134	1,430
6·0	·562	1·55	992	1·36	1,224	1·208	1,480
6·2	·600	1·65	1,023	1·45	1,264	1·284	1,529
6·4	·640	1·75	1,054	1·54	1,305	1·363	1,578
6·6	·680	1·86	1,092	1·63	1,346	1·444	1,627
6·8	·722	1·97	1,123	1·72	1,387	1·527	1,677
7·0	·765	2·08	1,144	1·82	1,428	1·612	1,727

TABLE VI.—*continued.*

FRICTION OF WATER IN PIPES PER 100 FEET LENGTH—*continued.*

Velocity of Water in Feet per Second.	Head in Feet to Produce this Velocity.	INTERNAL DIAMETER OF PIPE IN INCHES.					
		Head to Overcome Friction.	Gallons per Minute.	Head to Overcome Friction.	Gallons per Minute.	Head to Overcome Friction.	Gallons per Minute.
		12-inch.		14-inch.		15-inch.	
1·0	·016	·028	294	·031	400	·029	459
2·0	·062	·139	587	·115	799	·105	917
2·2	·075	·166	646	·137	879	·126	1,009
2·4	·090	·195	705	·161	959	·148	1,101
2·6	·105	·227	764	·187	1,039	·172	1,193
2·8	·122	·261	823	·215	1,119	·197	1,284
3·0	·140	·297	881	·245	1,199	·224	1,376
3·2	·160	·335	940	·276	1,279	·253	1,468
3·4	·180	·375	999	·309	1,359	·283	1,559
3·6	·202	·417	1,058	·344	1,439	·315	1,651
3·8	·225	·462	1,117	·381	1,519	·349	1,743
4·0	·250	·509	1,175	·419	1,599	·385	1,835
4·2	·275	·557	1,234	·459	1,679	·421	1,926
4·4	·302	·607	1,293	·501	1,759	·459	2,017
4·6	·330	·659	1,352	·544	1,839	·499	2,109
4·8	·360	·714	1,411	·589	1,919	·540	2,201
5·0	·390	·771	1,468	·636	1,999	·583	2,294
5·2	·422	·829	1,527	·684	2,079	·627	2,386
5·4	·455	·890	1,586	·734	2,159	·673	2,478
5·6	·490	·953	1,645	·786	2,239	·721	2,569
5·8	·525	1·018	1,704	·839	2,319	·770	2,660
6·0	·562	1·084	1,762	·894	2,399	·820	2,752
6·2	·600	1·152	1,821	·950	2,479	·872	2,844
6·4	·640	1·222	1,880	1·009	2,559	·925	2,936
6·6	·680	1·295	1,939	1·069	2,639	·980	3,027
6·8	·722	1·369	1,998	1·130	2,719	1·036	3,118
7·0	·765	1·446	2,056	1·193	2,799	1·094	3,210
		16-inch.		18-inch.		20-inch.	
1·0	·016	·026	522	·023	661	·020	816
2·0	·062	·097	1,044	·084	1,322	·073	1,632
2·2	·075	·116	1,149	·100	1,454	·088	1,795
2·4	·090	·126	1,254	·118	1,584	·103	1,958
2·6	·105	·159	1,359	·137	1,716	·120	2,121
2·8	·122	·182	1,464	·157	1,849	·138	2,284
3·0	·140	·207	1,566	·179	1,982	·157	2,444
3·2	·160	·233	1,671	·202	2,114	·177	2,610
3·4	·180	·261	1,776	·226	2,246	·198	2,774
3·6	·202	·291	1,880	·251	2,378	·220	2,937
3·8	·225	·322	1,984	·278	2,512	·243	3,100
4·0	·250	·355	2,088	·306	2,643	·268	3,263
4·2	·275	·389	2,193	·335	2,775	·294	3,426
4·4	·302	·424	2,298	·366	2,908	·321	3,589
4·6	·330	·460	2,402	·398	3,040	·348	3,752
4·8	·360	·498	2,506	·431	3,172	·377	3,916
5·0	·390	·538	2,611	·465	3,304	·407	4,080
5·2	·422	·579	2,716	·500	3,436	·438	4,243
5·4	·455	·621	2,820	·536	3,568	·470	4,406
5·6	·490	·665	2,925	·574	3,700	·503	4,569
5·8	·525	·710	3,029	·613	3,832	·537	4,732
6·0	·562	·757	3,133	·653	3,965	·572	4,895
6·2	·600	·805	3,238	·694	4,098	·608	5,058
6·4	·640	·854	3,342	·736	4,230	·646	5,221
6·6	·680	·904	3,447	·780	4,362	·684	5,384
6·8	·722	·956	3,551	·825	4,494	·723	5,547
7·0	·765	1·010	3,655	·871	4,625	·763	5,711
		21-inch.		22-inch.		24-inch.	
1·0	·016	·019	900	·018	986	·016	1,175
2·0	·062	·069	1,799	·065	1,974	·058	2,349
2·2	·075	·082	1,979	·078	2,172	·070	2,584
2·4	·090	·097	2,158	·092	2,370	·082	2,818
2·6	·105	·113	2,338	·107	2,568	·095	3,053
2·8	·122	·130	2,518	·122	2,765	·110	3,289
3·0	·140	·148	2,698	·139	2,961	·125	3,524
3·2	·160	·166	2,878	·157	3,159	·141	3,759
3·4	·180	·186	3,058	·176	3,357	·158	3,994
3·6	·202	·207	3,238	·195	3,555	·175	4,229
3·8	·225	·229	3,417	·216	3,752	·194	4,464
4·0	·250	·252	3,597	·238	3,948	·214	4,699
4·2	·275	·276	3,777	·261	4,145	·234	4,934
4·4	·302	·301	3,957	·284	4,343	·255	5,179
4·6	·330	·328	4,137	·309	4,540	·277	5,414
4·8	·360	·355	4,316	·335	4,738	·300	5,649
5·0	·390	·383	4,496	·361	4,935	·324	5,873
5·2	·422	·412	4,676	·389	5,132	·349	6,108
5·4	·455	·442	4,856	·417	5,330	·374	6,343
5·6	·490	·473	5,036	·446	5.528	·401	6,578
5·8	·525	·505	5,216	·477	5,725	·428	6,813
6·0	·562	·538	5,396	·508	5,922	·456	7,048
6·2	·600	·572	5,576	·540	6,120	·485	7,283
6·4	·640	·608	5,756	·573	6,318	·514	7,515
6·6	·680	·644	5,936	·607	6,515	·544	7,750
6·8	·722	·681	6,115	[illegible]	6.712	·576	7,986
7·0	·765	·719	6,285	·673	6,909	·608	8,223

TABLE VII.

WEIGHT AND BULK OF WATER.

Weight of 1 cubic foot of water 62·228 to 62·355 (according to temperature).

Fresh Water at 62 Degrees F.

1 cubic foot	= 6·2321 gallons.
1 gallon	= 10 lbs.
1 gallon	= ·161 cubic foot.
1 gallon	= 277¼ cubic inches (approximate).
1 ton	= 36 cubic feet (approximate).
1 acre inch	= 100 tons (approximate).

WEIGHT AND CAPACITY OF DIFFERENT STANDARD GALLONS OF WATER.

—	Cubic Inches in One Gallon.	Weight of One Gallon in Lbs.	Gallons in One Cubic Foot.
Imperial or English	277·274	10·000	6·2321
U.S.A. or American	231·000	8·3356	7·480

1 acre foot—66 by 660 by 1 = 43,560 cubic feet.
66 by 660 by 6·2321 = 271,470 gallons.

1 acre inch = 22,622 gallons.	7 acre inches = 158,354 gallons.
2 acre inches = 45,244 gallons	8 acre inches = 180,976 gallons.
3 acre inches = 67,866 gallons.	9 acre inches = 203,598 gallons.
4 acre inches = 90,488 gallons.	10 acre inches = 226,220 gallons.
5 acre inches = 113,110 gallons.	11 acre inches = 248,842 gallons.
6 acre inches = 135,732 gallons.	

TABLE VIII.

WEIR MEASUREMENT TABLE FOR WEIR 2 FEET WIDE (BY FRANCIS FORMULÆ).

Depth of Water over Lip of Weir. From Still Water.		Discharge.			Time Required to Pump Acre Inches as below.					
		Gallons per Minute.	Gallons per Day.	Acre Inches per Hour.	1		2		3	
Inches.	Feet.				Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.
1 ..	·083	59·4	85,564	·16	6	26	12	52	..	
$1\frac{1}{16}$ ..	·088	65·1	93,696	·17	5	48	11	36	..	
$1\frac{1}{8}$ ..	·094	70·9	102,030	·19	5	19	10	38	..	
$1\frac{3}{16}$ ..	·099	76·8	110,592	·20	4	56	9	52	..	
$1\frac{1}{4}$ ..	·104	82·9	119,367	·22	4	33	9	6	..	
$1\frac{5}{16}$ ..	·109	89·2	128,367	·23	4	14	8	28	..	
$1\frac{3}{8}$ ..	·115	95·5	137,575	·25	3	58	7	56	..	
$1\frac{7}{16}$ ..	·120	102	146,987	·27	3	42	7	24	11	6
$1\frac{1}{2}$ ..	·125	109	156,578	·28	3	28	6	56	10	24
$1\frac{9}{16}$ ..	·130	115·5	166,382	·30	3	16	6	32	9	48
$1\frac{5}{8}$ ..	·135	122·5	176,374	·32	3	5	6	10	9	15
$1\frac{11}{16}$ ..	·140	129·6	186,552	·34	2	55	5	50	8	45
$1\frac{3}{4}$ ..	·146	137	196,911	·36	2	45	5	30	8	15
$1\frac{13}{16}$ ..	·151	144	207,447	·38	2	37	5	14	7	51
$1\frac{7}{8}$ ..	·156	151·5	218,136	·40	2	30	5	0	7	30
$1\frac{15}{16}$ ..	·161	159	229,017	·42	2	22	4	44	7	6
2 ..	·167	166·8	240,077	·44	2	16	4	32	6	48
$2\frac{1}{16}$ ..	·172	174·5	251,275	·46	2	10	4	20	6	30
$2\frac{1}{8}$ ..	·177	182·4	262,648	·48	2	4	4	8	6	12
$2\frac{3}{16}$ ..	·182	190·4	274,178	·50	1	58	3	56	5	54
$2\frac{1}{4}$ ..	·187	198·2	285,842	·52	1	54	3	48	5	42
$2\frac{5}{16}$ ..	·192	206·6	297,680	·54	1	50	3	40	5	30
$2\frac{3}{8}$ ..	·198	215	309,670	·56	1	46	3	32	5	18
$2\frac{7}{16}$ ..	·203	223·5	321,806	·59	1	42	3	24	5	6
$2\frac{1}{2}$ ..	·208	232·6	334,089	·61	1	38	3	16	4	54
$2\frac{9}{16}$ ..	·213	241	346,515	·63	1	34	3	8	4	42
$2\frac{5}{8}$ ..	·219	249·2	359,059	·66	1	30	3	0	4	30
$2\frac{11}{16}$ ..	·224	258	371,764	·68	1	27	2	54	4	21
$2\frac{3}{4}$ ..	·229	267·1	384,607	·71	1	24	2	48	4	12
$2\frac{13}{16}$ ..	·234	276	397,586	·73	1	22	2	44	4	6
$2\frac{7}{8}$ ..	·240	285	410,697	·75	1	20	2	40	4	0
$2\frac{15}{16}$ ..	·245	294·5	423,937	·78	1	18	2	36	3	54
3 ..	·250	303·5	437,319	·80	1	15	2	30	3	45
$3\frac{1}{16}$ ..	·255	313	450,779	·83	1	12	2	24	3	36
$3\frac{1}{8}$ ..	·260	323	464,415	·85	1	10	2	20	3	30
$3\frac{3}{16}$ ..	·265	332	478,152	·88	1	8	2	16	3	24
$3\frac{1}{4}$ ..	·271	341·5	492,036	·90	1	6	2	12	3	18
$3\frac{5}{16}$ ..	·276	351·5	506,016	·93	1	4	2	8	3	12
$3\frac{3}{8}$ ..	·281	361	520,113	·95	1	2	2	4	3	6
$3\frac{7}{16}$ ..	·286	371	534,358	·98	1	1	2	2	3	3
$3\frac{1}{2}$ ..	·292	381	548,720	1·01	0	59	1	58	2	57
$3\frac{9}{16}$ ..	·297	391	563,169	1·03	0	58	1	56	2	54
$3\frac{5}{8}$ ..	·302	401	577,731	1·06	0	57	1	54	2	51
$3\frac{11}{16}$ ..	·307	411·5	592,436	1·09	0	55	1	50	2	45
$3\frac{3}{4}$ ..	·312	421·5	607,253	1·12	0	54	1	48	2	42
$3\frac{13}{16}$ ..	·318	432	622,149	1·14	0	53	1	46	2	39
$3\frac{7}{8}$ ..	·323	442·5	637,186	1·17	0	51	1	42	2	33
$3\frac{15}{16}$ ..	·328	453	652,268	1·20	0	50	1	40	2	30
4 ..	·333	463·5	667,520	1·23	0	49	1	38	2	27
$4\frac{1}{16}$ ..	·338	474	682,878	1·26	0	48	1	36	2	24
$4\frac{1}{8}$ ..	·344	485	698,304	1·28	0	47	1	34	2	21
$4\frac{3}{16}$ ..	·349	496	713,869	1·31	0	46	1	32	2	18
$4\frac{1}{4}$ ..	·355	506·5	729,500	1·34	0	45	1	30	2	15
$4\frac{5}{16}$ ..	·360	517·5	745,239	1·37	0	44	1	28	2	12
$4\frac{3}{8}$ ..	·365	528·5	761,109	1·40	0	43	1	26	2	9
$4\frac{7}{16}$ ..	·370	539·5	777,038	1·43	0	42	1	24	2	6
$4\frac{1}{2}$ ..	·375	551	793,105	1·46	0	41	1	22	2	3
$4\frac{9}{16}$ ..	·380	562	809,228	1·49	0	40	1	20	2	0
$4\frac{5}{8}$ ..	·385	573	825,489	1·52	0	39	1	18	1	57
$4\frac{11}{16}$ ..	·390	584·5	841,770	1·55	0	38·7	1	17·4	1	56
$4\frac{3}{4}$ ..	·396	596	858,220	1·58	0	38	1	16	1	54
$4\frac{13}{16}$ ..	·401	607·5	874,764	1·61	0	37	1	14	1	51
$4\frac{7}{8}$ ..	·406	619	891,354	1·64	0	36·5	1	13	1	49
$4\frac{15}{16}$ ..	·411	631	908,082	1·67	0	35·7	1	11·4	1	47
5 ..	·417	642	924,854	1·70	0	35·2	1	10·4	1	45·
$5\frac{1}{16}$ ..	·422	654	941,729	1·73	0	34·6	1	9·2	1	43·
$5\frac{1}{8}$ ..	·427	666	958,667	1·76	0	34	1	8	1	42
$5\frac{3}{16}$ ..	·432	678	975,763	1·79	0	33·3	1	6·6	1	39·

TABLE VIII.—*continued.*

WEIR MEASUREMENT TABLE FOR WEIR 2 FEET WIDE (BY FRANCIS FORMULÆ)—*continued.*

Depth of Water over Lip of Weir.		Discharge.			Time Required to Pump Acre Inches as below.					
From Still Water.		Gallons per Minute.	Gallons per Day.	Acre Inches per Hour.	4		5		6	
Inches.	Feet.				Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.
1 ..	·083	59·4	85,564	·16	..		..		..	
1 1/16 ..	·088	65·1	93,696	·17	..		..		..	
1 1/8 ..	·094	70·9	102,030	·19	..		..		..	
1 3/16 ..	·099	76·8	110,592	·20	..		..		..	
1 1/4 ..	·104	82·9	119,367	·22	..		..		..	
1 5/16 ..	·109	89·2	128,367	·23	..		..		..	
1 3/8 ..	·115	95·5	137,575	·25	..		..		..	
1 7/16 ..	·120	102	146,987	·27	..		..		..	
1 1/2 ..	·125	109	156,578	·28	..		..		..	
1 9/16 ..	·130	115·5	166,382	·30	..		..		..	
1 5/8 ..	·135	122·5	176,374	·32	..		..		..	
1 11/16 ..	·140	129·6	186,552	·34	..		..		..	
1 3/4 ..	·146	137	196,911	·36	..		..		..	
1 13/16 ..	·151	144	207,447	·38	..		..		..	
1 7/8 ..	·156	151·5	218,136	·40	10	0	..		..	
1 15/16 ..	·161	159	229,017	·42	9	28	..		..	
2 ..	·167	166·8	240,077	·44	9	4	..		..	
2 1/16 ..	·172	174·5	251,275	·46	8	40	..		..	
2 1/8 ..	·177	182·4	262,648	·48	8	16	10	20	..	
2 3/16 ..	·182	190·4	274,178	·50	7	52	9	50	..	
2 1/4 ..	·187	198·2	285,842	·52	7	36	9	30	..	
2 5/16 ..	·192	206·6	297,680	·54	7	20	9	10	..	
2 3/8 ..	·198	215	309,670	·56	7	4	8	50	..	
2 7/16 ..	·203	223·5	321,806	·59	6	48	8	30	10	12
2 1/2 ..	·208	232·6	334,089	·61	6	32	8	10	9	48
2 9/16 ..	·213	241	346,515	·63	6	16	7	50	9	22
2 5/8 ..	·219	249·2	359,059	·66	6	0	7	30	9	0
2 11/16 ..	·224	258	371,764	·68	5	48	7	15	8	42
2 3/4 ..	·229	267·1	384,607	·71	5	36	7	0	8	24
2 13/16 ..	·234	276	397,586	·73	5	28	6	50	8	12
2 7/8 ..	·240	285	410,697	·75	5	20	6	40	8	0
2 15/16 ..	·245	294·5	423,937	·78	5	12	6	30	7	48
3 ..	·250	303·5	437,319	·80	5	0	6	15	7	30
3 1/16 ..	·255	313	450,779	·83	4	48	6	0	7	12
3 1/8 ..	·260	323	464,415	·85	4	40	5	50	7	0
3 3/16 ..	·265	332	478,152	·88	4	32	5	40	6	48
3 1/4 ..	·271	341·5	492,036	·90	4	24	5	30	6	36
3 5/16 ..	·276	351·5	506,016	·93	4	16	5	20	6	24
3 3/8 ..	·281	361	520,113	·95	4	8	5	10	6	12
3 7/16	·286	371	534,358	·98	4	4	5	5	6	6
3 1/2 ..	·292	381	548,720	1·01	3	56	4	55	5	54
3 9/16 ..	·297	391	563,169	1·03	3	52	4	50	5	48
3 5/8 ..	·302	401	577,731	1·06	3	45	4	45	5	42
3 11/16 ..	·307	411·5	592,436	1·09	3	40	4	35	5	30
3 3/4 ..	·312	421·5	607,253	1·12	3	36	4	30	5	22
3 13/16 ..	·318	432	622,149	1·14	3	32	4	25	5	18
3 7/8 ..	·323	442·5	637,186	1·17	3	24	4	15	5	6
3 15/16 ..	·328	453	652,268	1·20	3	20	4	10	5	0
4 ..	·333	463·5	667,520	1·23	3	16	4	5	4	54
4 1/16 ..	·338	474	682,878	1·26	3	12	4	0	4	48
4 1/8 ..	·344	485	698,304	1·28	3	8	3	55	4	42
4 3/16 ..	·349	496	713,869	1·31	3	4	3	50	4	36
4 1/4 ..	·355	506·5	729,500	1·34	3	0	3	45	4	30
4 5/16 ..	·360	517·5	745,239	1·37	2	56	3	40	4	24
4 3/8 ..	·365	528·5	761,109	1·40	2	52	3	35	4	18
4 7/16 ..	·370	539·5	777,038	1·43	2	48	3	30	4	12
4 1/2 ..	·375	551	793,105	1·46	2	44	3	25	4	6
4 9/16 ..	·380	562	809,228	1·49	2	40	3	20	4	0
4 5/8 ..	·385	573	825,489	1·52	2	36	3	15	3	54
4 11/16 ..	·390	584·5	841,770	1·55	2	34	3	13	3	52
4 3/4 ..	·396	596	858,220	1·58	2	32	3	10	3	48
4 13/16 ..	·401	607·5	874,764	1·61	2	28	3	5	3	42
4 7/8 ..	·406	619	891,354	1·64	2	26	3	2	3	38
4 15/16 ..	·411	631	908,082	1·67	2	22	3	0	3	34
5 ..	·417	642	924,854	1·70	2	20	2	56	3	31
5 1/16 ..	·422	654	941,729	1·73	2	18	2	53	3	28
[illegible]	·427	666	958,667	1·76	2	16	2	50	3	24
[illegible]	·432	678	975,763	1·79	2	13	2	46	3	20

TABLE VIII.—*continued.*

WEIR MEASUREMENT TABLE FOR WEIR 2 FEET WIDE (BY FRANCIS FORMULÆ)—*continued.*

Depth of Water over Lip of Weir. From Still Water. Inches.	Feet.	Discharge. Gallons per Minute.	Gallons per Day.	Acre Inches per Hour.	Time Required to Pump Acre Inches as below. 1 Hrs.	1 Mins.	2 Hrs.	2 Mins.	3 Hrs.	3 Mins.
$5\frac{1}{4}$ ..	·437	689·5	992,937	1·82	0	32·8	1	5·6	1	38·4
$5\frac{5}{16}$ ..	·443	701·5	1,010,145	1·86	0	32·2	1	4·4	1	36·6
$5\frac{3}{8}$ ..	·448	713	1,027,491	1·89	0	31·7	1	3·4	1	35·1
$5\frac{7}{16}$ ..	·453	725	1,044,834	1·92	0	31·2	1	2·4	1	33·6
$5\frac{1}{2}$ ..	·458	738	1,062,349	1·96	0	30·6	1	1·2	1	31·8
$5\frac{9}{16}$ ..	·463	749·5	1,079,950	1·99	0	32·2	1	0·4	1	30·6
$5\frac{5}{8}$ ..	·469	763	1,097,573	2·02	0	29·6	0	59·2	1	28·8
$5\frac{11}{16}$ ..	·474	775	1,115,343	2·05	0	29·2	0	58·4	1	27·6
$5\frac{3}{4}$ ..	·479	787	1,133,124	2·08	0	28·7	0	57·4	1	26·1
$5\frac{13}{16}$ ..	·484	799	1,151,015	2·12	0	28·3	0	56·6	1	24·9
$5\frac{7}{8}$ ..	·489	812	1,168,958	2·15	0	27·8	0	55·6	1	23·4
$5\frac{15}{16}$ ..	·495	824·5	1,187,043	2·18	0	27·4	0	54·8	1	22·2
6 ..	·500	837	1,205,210	2·22	0	27	0	54	1	21
$6\frac{1}{16}$ ..	·505	850	1,223,349	2·25	0	26·6	0	53·2	1	19·8
$6\frac{1}{8}$ ..	·510	862	1,241,625	2·28	0	26·2	0	52·4	1	18·6
$6\frac{3}{16}$ ..	·516	875	1,259,997	2·32	0	25·8	0	51·6	1	17·4
$6\frac{1}{4}$ ..	·521	888	1,278,467	2·35	0	25·4	0	50·8	1	16·2
$6\frac{5}{16}$ ..	·526	901	1,296,909	2·39	0	25·1	0	50·2	1	15·3
$6\frac{3}{8}$ ..	·531	914	1,315,529	2·42	0	24·7	0	49·4	1	14·1
$6\frac{7}{16}$ ..	·536	927	1,334,225	2·46	0	24·4	0	48·8	1	13·2
$6\frac{1}{2}$ ..	·542	940	1,352,922	2·49	0	24	0	48	1	12
$6\frac{9}{16}$ ..	·547	953	1,371,765	2·52	0	23·7	0	47·4	1	11·1
$6\frac{5}{8}$ ..	·552	966	1,390,603	2·56	0	23·4	0	46·8	1	10·2
$6\frac{11}{16}$ ..	·557	979	1,409,550	2·60	0	23·1	0	46·2	1	9·3
$6\frac{3}{4}$ ..	·562	992	1,428,602	2·63	0	22·8	0	45·6	1	8·4
$6\frac{13}{16}$ ..	·568	1,005	1,447,656	2·66	0	22·5	0	45	1	7·5
$6\frac{7}{8}$ ..	·573	1,018	1,466,856	2·70	0	22·2	0	44·4	1	6·6
$6\frac{15}{16}$ ..	·578	1,032	1,486,032	2·74	0	21·9	0	43·8	1	5·7
7 ..	·583	1,045	1,505,370	2·77	0	21·6	0	43·2	1	4·8
$7\frac{1}{16}$ ..	·588	1,059	1,524,656	2·81	0	21·3	0	42·6	1	3·9
$7\frac{1}{8}$ ..	·594	1,072	1,544,126	2·84	0	21·1	0	42·2	1	3·3
$7\frac{3}{16}$ ..	·599	1,086	1,563,667	2·88	0	20·8	0	41·6	1	2·4
$7\frac{1}{4}$ ..	·604	1,100	1,583,183	2·92	0	20·5	0	41	1	1·5
$7\frac{5}{16}$ ..	·609	1,113	1,602,853	2·95	0	20·3	0	40·6	1	0·9
$7\frac{3}{8}$ ..	·614	1,127	1,622,502	2·99	0	20	0	40	1	0
$7\frac{7}{16}$ ..	·620	1,140	1,642,262	3·02	0	19·8	0	39·6	0	59·4
$7\frac{1}{2}$ ..	·625	1,154	1,662,167	3·06	0	19·6	0	39·2	0	58·8
$7\frac{9}{16}$ ..	·630	1,168	1,681,966	3·09	0	19·3	0	38·6	0	57·9
$7\frac{5}{8}$ ..	·635	1,182	1,701,958	3·13	0	19·1	0	38·2	0	57·3
$7\frac{11}{16}$ ..	·641	1,196	1,721,922	3·17	0	18·9	0	37·8	0	56·7
$7\frac{3}{4}$ ..	·646	1,210	1,742,039	3·21	0	18·7	0	37·4	0	56·1
$7\frac{13}{16}$ ..	·651	1,224	1,762,084	3·24	0	18·5	0	37	0	55·5
$7\frac{7}{8}$ ..	·656	1,238	1,782,324	3·28	0	18·2	0	36·4	0	54·6
$7\frac{15}{16}$ ..	·661	1,252	1,802,530	3·32	0	18	0	36	0	54
8 ..	·666	1,266	1,822,893	3·36	0	17·8	0	35·6	0	53·4
$8\frac{1}{16}$ ..	·672	1,280	1,843,315	3·39	0	17·6	0	35·2	0	52·8
$8\frac{1}{8}$ ..	·677	1,294	1,863,698	3·43	0	17·4	0	34·8	0	52·2
$8\frac{3}{16}$ ..	·682	1,308	1,884,197	3·47	0	17·3	0	34·6	0	51·9
$8\frac{1}{4}$ ..	·687	1,322	1,904,697	3·50	0	17·1	0	34·2	0	51·3
$8\frac{5}{16}$ ..	·693	1,337	1,925,354	3·54	0	16·9	0	33·8	0	50·7
$8\frac{3}{8}$ ..	·698	1,352	1,946,070	3·58	0	16·7	0	33·4	0	50·1
$8\frac{7}{16}$ ..	·703	1,366	1,966,740	3·62	0	16·5	0	33	0	49·5
$8\frac{1}{2}$ ..	·708	1,380	1,987,570	3·66	0	16·4	0	32·8	0	49·2
$8\frac{9}{16}$ ..	·713	1,395	2,008,307	3·70	0	16·2	0	32·4	0	48·6
$8\frac{5}{8}$ ..	·719	1,409	2,029,250	3·73	0	16	0	32	0	48
$8\frac{11}{16}$ ..	·724	1,424	2,050,140	3·77	0	15·8	0	31·6	0	47·4
$8\frac{3}{4}$ ..	·729	1,439	2,071,193	3·81	0	15·7	0	31·4	0	47·1
$8\frac{13}{16}$ ..	·734	1,453	2,092,302	3·85	0	15·5	0	31	0	46·5
$8\frac{7}{8}$ ..	·739	1,468	2,113,352	3·89	0	15·4	0	30·8	0	46·2
$8\frac{15}{16}$ ..	·744	1,482	2,134,526	3·93	0	15·2	0	30·4	0	45·6
9 ..	·750	1,497	2,155,841	3·97	0	15	0	30	0	45
$9\frac{1}{16}$ ..	·755	1,512	2,177,005	4·01	0	14·9	0	29·8	0	44·7
$9\frac{1}{8}$ ..	·760	1,526	2,198,263	4·04	0	14·7	0	29·4	0	44·1
$9\frac{3}{16}$ ..	·766	1,542	2,219,694	4·09	0	14·6	0	29·2	0	43·8
$9\frac{1}{4}$ ..	·771	1,557	2,241,175	4·13	0	14·5	0	29	0	43·5
$9\frac{5}{16}$ ..	·776	1,571	2,262,542	4·16	0	14·4	0	28·8	0	43·2
$9\frac{3}{8}$ ..	·781	1,586	2,284,127	4·20	0	14·2	0	28·4	0	42·6
$9\frac{7}{16}$ ..	·786	1,601	2,305,637	4·24	0	14·1	0	28·2	0	42·3

TABLE VIII.—*continued.*

WEIR MEASUREMENT TABLE FOR WEIR 2 FEET WIDE (BY FRANCIS FORMULÆ)—*continued.*

Depth of Water over Lip of Weir.		Discharge.			Time Required to Pump Acre Inches as Below.					
From Still Water.		Gallons per Minute.	Gallons per Day.	Acre Inches per Hour.	4		5		6	
Inches.	Feet.				Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.
$5\frac{1}{4}$ ..	·437	689·5	992,937	1·82	2	11	2	44	3	16
$5\frac{5}{16}$ ..	·443	701·5	1,010,145	1·86	2	9	2	41	3	13
$5\frac{3}{8}$ ..	·448	713	1,027,491	1·89	2	7	2	39	3	10
$5\frac{7}{16}$ ..	·453	725	1,044,834	1·92	2	5	2	36	3	7
$5\frac{1}{2}$ ..	·458	738	1,062,349	1·96	2	2	2	33	3	4
$5\frac{9}{16}$ ..	·463	749·5	1,079,950	1·99	2	1	2	31	3	1
$5\frac{5}{8}$ ..	·469	763	1,097,573	2·02	1	58	2	28	2	57
$5\frac{11}{16}$ ..	·474	775	1,115,343	2·05	1	56	2	26	2	55
$5\frac{3}{4}$ ..	·479	787	1,133,124	2·08	1	54	2	23	2	52
$5\frac{13}{16}$ ..	·484	799	1,151,015	2·12	1	53	2	21	2	49
$5\frac{7}{8}$ ..	·489	812	1,168,958	2·15	1	51	2	19	2	46
$5\frac{15}{16}$ ..	·495	824·5	1,187,043	2·18	1	49	2	17	2	44
6 ..	·500	837	1,205,210	2·22	1	48	2	15	2	42
$6\frac{1}{16}$ ..	·505	850	1,223,349	2·25	1	46	2	13	2	39
$6\frac{1}{8}$ ..	·510	862	1,241,625	2·28	1	44	2	11	2	37
$6\frac{3}{16}$ ..	·516	875	1,259,997	2·32	1	43	2	9	2	35
$6\frac{1}{4}$ ..	·521	888	1,278,467	2·35	1	41	2	7	2	32
$6\frac{5}{16}$ ..	·526	901	1,296,909	2·39	1	40	2	5	2	30
$6\frac{3}{8}$ ..	·531	914	1,315,529	2·42	1	39	2	3	2	28
$6\frac{7}{16}$ ..	·536	927	1,334,225	2·46	1	37	2	2	2	26
$6\frac{1}{2}$ ..	·542	940	1,352,922	2·49	1	36	2	0	2	24
$6\frac{9}{16}$ ..	·547	953	1,371,765	2·52	1	34	1	58	2	22
$6\frac{5}{8}$ ..	·552	966	1,390,603	2·56	1	33	1	57	2	20
$6\frac{11}{16}$	·557	979	1,409,550	2·60	1	32	1	55	2	18
$6\frac{3}{4}$ ..	·562	992	1,428,602	2·63	1	31	1	54	2	17
$6\frac{13}{16}$ ..	·568	1,005	1,447,656	2·66	1	30	1	52	2	15
$6\frac{7}{8}$ ..	·573	1,018	1,466,856	2·70	1	28	1	51	2	13
$6\frac{15}{16}$ ..	·578	1,032	1,486,032	2·74	1	27	1	49	2	11
7 ..	·583	1,045	1,505,370	2·77	1	26	1	48	2	9
$7\frac{1}{16}$ ..	·588	1,059	1,524,656	2·81	1	25	1	46	2	7
$7\frac{1}{8}$ ..	·594	1,072	1,544,126	2·84	1	24	1	45	2	6
$6\frac{3}{16}$ ..	·599	1,086	1,563,667	2·88	1	23	1	44	2	5
$7\frac{1}{4}$ ..	·604	1,100	1,583,183	2·92	1	22	1	42	2	3
$7\frac{5}{16}$ ..	·609	1,113	1,602,853	2·95	1	21	1	41	2	1
$7\frac{3}{8}$ ..	·614	1,127	1,622,502	2·99	1	20	1	40	2	0
$7\frac{7}{16}$ ..	·620	1,140	1,642,262	3·02	1	19	1	39	1	59
$7\frac{1}{2}$ ..	·625	1,154	1,662,167	3·06	1	18	1	37	1	57
$7\frac{9}{16}$ ..	·630	1,168	1,681,966	3·09	1	17	1	36	1	56
$7\frac{5}{8}$ ..	·635	1,182	1,701,958	3·13	1	16	1	35	1	55
$7\frac{11}{16}$ ..	·641	1,196	1,721,922	3·17	1	15	1	34	1	53
$7\frac{3}{4}$ ..	·646	1,210	1,742,039	3·21	1	15	1	33	1	52
$7\frac{13}{16}$ ..	·651	1,224	1,762,084	3·24	1	14	1	32	1	51
$7\frac{7}{8}$ ..	·656	1,238	1,782,324	3·28	1	13	1	31	1	49
$7\frac{15}{16}$ ..	·661	1,252	1,802,530	3·32	1	12	1	30	1	48
8 ..	·666	1,266	1,822,893	3·36	1	11	1	29	1	46
$8\frac{1}{16}$ ..	·672	1,280	1,843,315	3·39	1	10	1	28	1	45
$8\frac{1}{8}$ ..	·677	1,294	1,863,698	3·43	1	9	1	27	1	44
$8\frac{3}{16}$ ..	·682	1,308	1,884,197	3·47	1	9	1	26	1	44
$8\frac{1}{4}$ ..	·687	1,322	1,904,697	3·50	1	8	1	25	1	43
$8\frac{5}{16}$ ..	·693	1,337	1,925,354	3·54	1	7	1	24	1	42
$8\frac{3}{8}$ ..	·698	1,352	1,946,070	3·58	1	7	1	23	1	41
$8\frac{7}{16}$ ..	·703	1,366	1,966,740	3·62	1	6	1	22	1	40
$8\frac{1}{2}$ ..	·708	1,380	1,987,570	3·66	1	6	1	22	1	39
$8\frac{9}{16}$ ..	·713	1,395	2,008,307	3·70	1	5	1	21	1	38
$8\frac{5}{8}$ ..	·719	1,409	2,029,250	3·73	1	4	1	20	1	37
$8\frac{11}{16}$ ..	·724	1,424	2,050,140	3·77	1	3	1	19	1	36
$8\frac{3}{4}$ ..	·729	1,439	2,071,193	3·81	1	2·8	1	18·5	1	34
$8\frac{13}{16}$ ..	·734	1,453	2,092,302	3·85	1	2	1	16·5	1	35
$8\frac{7}{8}$ ..	·739	1,468	2,113,352	3·89	1	1·6	1	16·2	1	32
$8\frac{15}{16}$ ..	·744	1,482	2,134,526	3·93	1	0·4	1	16	1	31
9 ..	·750	1,497	2,155,841	3·97	1	0	1	15	1	30
$9\frac{1}{16}$ ..	·755	1,512	2,177,005	4·01	0	59·6	1	14·5	1	29
$9\frac{1}{8}$ ..	·760	1,526	2,198,263	4·04	0	58·8	1	13·5	1	28
$9\frac{3}{16}$ ..	·766	1,542	2,219,694	4·09	0	58·4	1	13	1	27
$9\frac{1}{4}$ ..	·771	1,557	2,241,175	4·13	0	58	1	12·5	1	27
$9\frac{5}{16}$ ..	·776	1,571	2,262,542	4·16	0	57·6	1	12	1	26
$9\frac{3}{8}$ ..	·781	1,586	2,284,127	4·20	0	56·8	1	11	1	25
$9\frac{7}{16}$ ..	·786	1,601	2,305,637	4·24	0	56·4	1	10·5	1	24

TABLE X.

FLOW OF WATER IN CHANNELS.

Fall of Ditch.		T—2 ft. 4 in.; B—1 ft.; D—4 ft.			T—3 ft.; B—1 ft.; D—6 in.		
Feet per Mile.	Inches per Chain.	Velocity—Feet per Second.	Gallons per Minute.	Acre Inches per Hour.	Velocity—Feet per Second.	Gallons per Minute.	Acre Inches per Hour.
·5	·075	·14	29	·08	·19	69	·19
1·0	·150	·21	44	·12	·28	104	·27
1·5	·225	·26	55	·15	·35	131	·35
2·0	·330	·31	64	·18	·41	154	·41
2·5	·375	·35	73	·20	·46	173	·46
3·0	·450	·39	80	·22	·51	191	·50
3·5	·525	·42	86	·23	·55	207	·54
4·0	·600	·45	93	·25	·59	222	·59
4·5	·675	·48	99	·27	·63	236	·62
5·0	·750	·51	105	·28	·67	249	·66
5·5	·825	·53	110	·29	·70	262	·69
6·0	·900	·56	115	·30	·73	274	·73
6·5	·975	·58	120	·32	·76	286	·75
7·0	1·050	·60	124	·33	·79	297	·78
7·5	1·125	·62	129	·34	·82	308	·81
8·0	1·200	·64	134	·36	·85	318	·84
8·5	1·275	·66	138	·37	·88	328	·87
9·0	1·350	·68	142	·38	·90	338	·89
9·5	1·425	·70	146	·39	·93	347	·92
10·0	1·500	·72	150	·40	·95	356	·94

(Table IX. was published in the Text—Ed.)

Fall of Ditch.		T—3 ft. 4 in.; B—1 ft.; D—7 inches			T—3 ft. 8 in.; B—1 ft.; D—8 inches.		
Feet per Mile.	Inches per Chain.	Velocity.	Gallons per Minute.	Acre inches per Hour.	Velocity.	Gallons per Minute.	Acre inches per hour.
·5	·075	·21	97	·26	·23	132	·35
1·0	·150	·31	147	·39	·34	198	·52
1·5	·225	·39	184	·49	·43	249	·66
2·0	·330	·46	216	·56	·50	291	·77
2·5	·375	·51	243	·64	·56	328	·87
3·0	·450	·57	268	·71	·62	361	·95
3·5	·525	·61	290	·77	·67	392	1·03
4·0	·600	·66	312	·83	·72	420	1·12
4·5	·675	·70	331	·88	·77	447	1·18
5·0	·750	·74	350	·93	·81	472	1·25
5·5	·825	·78	368	·97	·85	496	1·31
6·0	·900	·81	385	1·02	·89	518	1·37
6·5	·975	·85	401	1·06	·93	540	1·43
7·0	1·050	·88	416	1·11	·96	561	1·49
7·5	1·125	·91	432	1·14	1·00	581	1·54
8·0	1·200	·94	446	1·18	1·03	601	1·60
8·5	1·275	·97	460	1·22	1·06	620	1·64
9·0	1·350	1·00	474	1·26	1·09	638	1·69
9·5	1·425	1·03	487	1·29	1·12	656	1·74
10·0	1·500	1·06	500	1·33	1·15	673	1·78

Fall of Ditch.		T—4 ft.; B—1 ft.; D—9 in.			T—4 ft. 4 in.; B—1 ft.; D—10 in.		
Feet per Mile.	Inches per Chain.	Velocity.	Gallons per Minute.	Acre Inches per Hour.	Velocity.	Gallons per Minute.	Acre Inches per Hour.
·5	·075	·25	174	·46	·27	221	·59
1·0	·150	·37	260	·69	·40	330	·88
1·5	·225	·46	325	·86	·50	413	1·09
2·0	·330	·54	380	1·00	·58	483	1·28
2·5	·375	·61	429	1·13	·65	544	1·44
3·0	·450	·67	472	1·25	·72	598	1·58
3·5	·525	·73	512	1·36	·78	649	1·71
4·0	·600	·78	549	1·45	·84	696	1·85
4·5	·675	·83	583	1·55	·89	740	1·96
5·0	·750	·88	616	1·63	·94	780	2·06
5·5	·825	·92	650	1·72	·99	821	2·18
6·0	·900	·96	677	1·78	1·03	858	2·27
6·5	·975	1·00	705	1·87	1·07	893	2·36
7·0	1·050	1·04	732	1·95	1·11	929	2·46
7·5	1·125	1·08	759	2·01	1·16	961	2·55
8·0	1·200	1·12	784	2·07	1·20	995	2·63
8·5	1·275	1·15	808	2·14	1·23	1,025	2·71
9·0	1·350	1·18	832	2·21	1·27	1,056	2·81
9·5	1·425	1·22	855	2·27	1·30	1,085	2·88
10·0	1·500	1·25	878	2·33	1·34	1,115	2·95

TABLE X—*continued.*

Fall of Ditch.		T—4 ft. 8 in.; B—1 ft.; D—11 in.			T—5 ft.; B—1 ft.; D—12 in.		
Feet per Mile.	Inches per Chain.	Velocity.	Gallons per Minute.	Acre Inches per Hour.	Velocity.	Gallons per Minute.	Acre Inches per Hour.
·5	·075	·29	278	·74	·30	342	·90
1·0	·150	·43	414	1·09	·45	508	1·34
1·5	·225	·53	518	1·37	·56	634	1·68
2·0	·330	·62	606	1·61	·66	742	1·97
2·5	·375	·70	681	1·81	·74	835	2·22
3·0	·450	·77	750	1·99	·82	917	2·43
3·5	·525	·83	813	2·15	·89	995	2·64
4·0	·600	·89	871	2·31	·95	1,066	2·82
4·5	·675	·95	926	2·46	1·01	1,133	3·00
5·0	·750	1·00	978	2·60	1·06	1,197	3·17
5·5	·825	1·05	1,027	2·73	1·12	1,255	3·32
6·0	·900	1·10	1,075	2·85	1·17	1,316	3·48
6·5	·975	1·15	1,120	2·98	1·21	1,358	3·59
7·0	1·050	1·19	1,163	3·08	1·26	1,418	3·74
7·5	1·125	1·24	1,205	3·20	1·31	1,472	3·89
8·0	1·200	1·28	1,245	3·29	1·35	1,523	4·04
8·5	1·275	1·32	1,283	3·40	1·39	1,570	4·16
9·0	1·350	1·36	1,323	3·50	1·44	1,616	4·25
9·5	1·425	1·39	1,360	3·61	1·48	1,662	4·32
10·0	1·500	1·43	1,395	3·70	1·52	1,705	4·39

TABLE XI.

TABLE SHOWING CHARACTERISTICS OF THREE PUMPS DELIVERING 800 GALLONS PER MINUTE THROUGH 70-FOOT TOTAL HEAD.

Pump.	Speed R.P.M.	Efficiency, Per cent.	H.P. Required.
4-inch	1,075	41	35
5-inch	785	60	23
6-inch	690	62	24

PERFORMANCE OF 2-INCH, 3-INCH, 4-INCH, AND 5-INCH PUMPS UNDER DIFFERENT HEADS—CAPACITY IN GALLONS PER MINUTE.

2-INCH PUMP.—Total head in feet (efficiency 40 or over).

Motor. H.P.	Motor. R.P.M.	10	15	20	25	30	35	40	50	60	70	80	90	100
5	1,700	..	..	..	..	..	..	160	140	110	70	..	..	..
3	1,700	..	..	..	..	..	140	120	85	..	..	..	..	..
2	1,700	..	150	135	125	110	80	45	..	..	..	..	..	..
3	1,400	175	168	159	148	135	115	95	50	..	..	..	..	..
2	1,400	160	145	130	110	90	70	45	..	..	..	..	..	..
				3-INCH PUMP.—Total head in feet (efficiency 50 or over).										
10	1,700	..	..	..	..	..	..	..	..	330	285	200	..	..
7½	1,700	..	..	..	..	..	..	350	300	245	125	..	..	..
5	1,700	..	..	..	335	315	280	255	175	..	..	..	..	..
3	1,700	..	300	280	260	225	175	75	..	..	..	..	..	..
2	1,700	260	230	190	125	..	..	..	..	..	..	..	..	..
7½	1,400	..	..	..	..	340	315	290	225	..	..	..	..	..
5	1,400	..	..	340	310	280	250	215	100	..	..	..	..	..
3	1,400	300	280	265	235	195	135	..	..	..	..	..	..	..
				4-INCH PUMP.—Total head in feet (efficiency 55 or over).										
15	1,700	..	..	..	..	..	..	..	..	520	450	360	..	..
10	1,700	..	..	..	..	..	..	500	415	340	240	..	..	..
7½	1,700	..	500	475	450	425	390	355	260	..	..	..	..	..
5	1,700	460	430	395	350	305	250	180	..	..	..	..	..	..
7½	1,400	..	..	..	..	520	480	450	370	260	..	..	..	..
5	1,400	..	475	455	430	400	355	300	..	..	..	..	..	..
3	1,400	390	360	325	290	240	175	..	..	..	..	..	..	..
				5-INCH PUMP.—Total head in feet (efficiency 60 or over).										
25	1,700	..	..	..	..	..	..	..	..	..	800	750	620	400
15	1,700	..	..	..	..	..	..	..	..	710	630	520	350	..
15	1,700	..	..	..	..	770	740	700	610	..	..	..	..	..
7½	1,700	..	..	..	650	600	560	510	440	360	..	..	..	..
5	1,700	600	550	500	450	375	300	200	..	..	..	..	..	..
15	1,400	..	..	..	..	..	..	750	675	560	400	..	..	..
10	1,400	..	..	..	..	700	650	610	500	350	..	..	..	..
7½	1,400	..	..	..	600	560	500	450	250	..	..	..	..	..
5	1,400	550	530	500	450	400	300	..	..	..	..	..	..	..

TABLE XII.

(FROM U.S.A. BULLETIN, NO. 158.)

Length of Base of Triangle.	Number of times Triangle must be applied in a mile.	Length of Leg at B to get fall of—						
		4 ft. per mile.	5 ft. per mile.	6 ft. per mile.	7 ft. per mile.	8 ft. per mile.	9 ft. per mile.	10 ft. per mile.
Feet.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
10	528	$0\frac{1}{16}$	$0\frac{1}{8}$	$0\frac{1}{8}$	$0\frac{3}{16}$	$0\frac{3}{16}$	$0\frac{3}{16}$	$0\frac{1}{4}$
11	480	$0\frac{1}{8}$	$0\frac{1}{8}$	$0\frac{1}{8}$	$0\frac{3}{16}$	$0\frac{3}{16}$	$0\frac{1}{4}$	$0\frac{1}{4}$
12	440	$0\frac{1}{8}$	$0\frac{1}{8}$	$0\frac{3}{16}$	$0\frac{3}{16}$	$0\frac{3}{16}$	$0\frac{1}{4}$	$0\frac{1}{4}$
15	352	$0\frac{1}{8}$	$0\frac{3}{16}$	$0\frac{3}{16}$	$0\frac{1}{4}$	$0\frac{1}{4}$	$0\frac{5}{16}$	$0\frac{5}{16}$
16	330	$0\frac{1}{8}$	$0\frac{3}{16}$	$0\frac{3}{16}$	$0\frac{1}{4}$	$0\frac{5}{16}$	$0\frac{5}{16}$	$0\frac{3}{8}$
$16\frac{1}{2}$	320	$0\frac{1}{8}$	$0\frac{3}{16}$	$0\frac{1}{4}$	$0\frac{1}{4}$	$0\frac{5}{16}$	$0\frac{5}{16}$	$0\frac{3}{8}$

NOTE.—It is obviously not possible to get a greater accuracy with this implement than that which may be assumed from above Table. Where extreme accuracy is necessary spirit-levelling must be resorted to.

TABLE XIII.

SHOWING FLOW OF WATER THROUGH 8-INCH BY 12-INCH SLUICE BOXES.

Height of Opening.	8 Inches Wide. Gallons per minute.	12 Inches Wide. Gallons per minute.	Height of Opening.	8 Inches Wide. Gallons per minute.	12 Inches Wide. Gallons per minute.
1 inch ..	103	153	7 inch ..	580	875
2 inch ..	196	300	8 inch ..	624	942
3 inch ..	284	432	9 inch ..	674	1,008
4 inch ..	364	553	10 inch ..	708	1,075
5 inch ..	464	666	11 inch ..	750	1,158
6 inch ..	510	774			

Figures above approximate to result given by Q. 1250 L —
Depth of water above bottom of opening.
Depth of water above top of opening.

APPENDIX I.

CENTRIFUGAL PUMP DATA SHEET.

Data Required for Estimates.

The conditions under which pumping units operate vary considerably. In order to enable us to furnish final figures and correct recommendations by return mail, the purchaser should give the information requested below. In sending inquiries, please answer all the questions as fully as possible, for by so doing you will assist us in making proper recommendations. Fill in this sheet and mail with inquiry.

Capacity, &c.

1. Number of pumps required..........
2. Capacity of each..........U.S. gallons per minute.
3. Character of liquid—Fresh water, muddy, gritty, acidulous, solids in suspension ?..........
4. If solid matter is contained, state size and character of largest pieces..........
5. Temperature of liquid..........° Fahr. Specific gravity..........
6. Service continuous.......... Service intermittent..........

Head.

7. Discharge head..........ft. (This is the vertical distance between the floor level of the pump and the point at which the water is discharged.)
8. Diameter of discharge pipe.......... Length..........
9. Number of elbows in discharge pipe..........45 or 90 degrees.......... Long or short radius..........
10. Suction lift..........ft. (This is the vertical distance from the floor level of the pump down to the surface of the water from which supply is taken.)
11. Suction head..........ft. (Sometimes the pump is placed so that water will flow into it. In such case the pressure at the suction opening of the pump should be stated and Question No. 10 omitted.)
12. Diameter of suction pipe..........length..........
13. Number of elbows in suction pipe..........45 or 90 degrees.......... Long or short radius..........
14. Variation in discharge head, if any..........
15. Variation in suction lift, if any..........in suction head..........

Motive Power.

16. Belted—Give speed of motive power..........diameter of driving pully..........
17. Direct connected to motor—Direct current, voltage..........alternating current, voltage..........cycles..........phase..........
18. Direct connection to steam turbine—Steam pressure..........condensing.......... Non-condensing..........
19. Direct connection to steam engine—Steam pressure..........condensing.......... Non-condensing..........
20. Motive power furnished by purchaser..........by builder..........
21. Remarks..........
....
....
....

APPENDIX II.

RELATIVE COST OF PUMPING BY ELECTRICITY AND GASOLINE.

No general rules can be given for cost of pumping, owing to variation in local power rates. The following examples will serve as a general guide.

Comparative operating costs of gasoline and electrically-driven pumping plants in California, from tests made by Agriculture Department, corrected for current prices of gasoline :—

Average Results.

Average results from actual tests are given in each case, and no attempt made to reconcile these figures, so that same can only be used as a general guide. The result for electric plants are for units owned and operated by large irrigation companies who keep accurate records of attendance and repairs, and in addition have heavy items of administrative expense, so that these charges are not strictly comparable with the corresponding items for small privately owned gasoline plants, which represent all but three of the gasoline plants tested.

—	Gasoline Plants.	Electric Plants.
Number of tests	11	13
Discharge—G.P.M.	759	526
Total lift—feet	87·9	77·3
Useful water horse-power	10·24	9·93
Indicated horse-power	28·36	23·68
Plant efficiency	35 per cent.	42 per cent.
Power consumed per hour (gallons gasoline, KWH, elec.)	3·15	17·68
Power consumed per useful water HPH	·360 gal.	1·95 KW
Number of hours plant runs per year	1,349	2,096
Power used per year (gallons gasoline, KWH, elec.)	5,364	41,161
Power cost (gallons gasoline, KWH, elec.)	$0·08	$0·022
Total cost of plant	$2,832	$2,971
Fixed charges per year (20 per cent. gasoline, 15 per cent. motor)	$566	$446
Cost of power per year	$429	$913
Cost of attendance and repair per year	$126	$255
Total cost per year	$1,121	$1,614
Fixed charges per useful water HPH	0·179	0·041
Power charges per useful water HPH	0·029	0·042
Attendance and repair per water HPH	0·018	0·011
Total	0·226	0·097

APPENDIX III.

WEIGHT AND COMPARATIVE VALUES OF WOOD FUEL.

One cord of wood—4 feet by 4 feet by 8 feet = 128 cubic feet.

One cord of air-dried hickory, hard maple, or Australian hardwood weighs about 4,500 lb., and is equal to one ton of coal.

One cord of air-dried white oak weighs about 3,850 lb., and is equal to about 1,715 lb. of coal.

One cord air-dried beech, red oak, or black oak, weighs about 3,250 lb., and is equal to about 1,450 lb. of coal.

One cord of air-dried pine weighs about 2,000 lb., and is equal to about 920 lb. of coal.

From the above it is safe to assume that 2¼ lb. of dry wood is equal to one pound of average coal, and that the full value of the same weights of different woods is very nearly the same. That is, a pound of hardwood is worth as much and no more than a pound of pine, assuming both to be dry.

It is important that the wood be dry, as for every 10 per cent. of moisture present, the loss of heating value is about 12 per cent.

APPENDIX IV.

FLOW IN FLUMES.

VELOCITY IN FEET PER SECOND AND QUANTITY IN GALLONS PER MINUTE FOR VARIOUS SIZES OF FLUMES WITH FAIRLY SMOOTH SURFACES—UNPLANED PLANK OR CONCRETE FLUMING.

Velocity in feet per second = $Cr^{0.67}s^{0.54}$

S. Slope.
r. Hydraulic radius in feet.
C. Constant—160.

Slope per 100 feet.	Cross Section in Feet.										
	1 by ½.	1½ by ¾.	2 by 1.	3 by 1½.	4 by 2.	5 by 2½.	6 by 3.	7 by 3½.	8 by 4.	9 by 4½.	10 by 5.
¾-inch—Velocity in feet per second ..	1·18	1·54	1·87	2·46	2·98	3·46	3·91	4·33	4·74	5·13	5·50
Gallons per minute	220	650	1,400	4,140	8,920	16,200	26,300	39,700	56,700	77,700	103,000
1½-inch—Velocity in feet per second ..	1·71	2·24	2·72	3·57	4·33	5·03	5·68	6·30	6·89	7·46	..
Gallons per minute	320	940	2,030	6,010	13,000	23,500	38,200	57,700	82,400	113,000	..
3-inch—Velocity in feet per second ..	2·49	3·26	3·96	5·19	6·30	7·31	8·26	9·16	10·02	..	..
Gallons per minute	470	1,370	2,960	8,730	18,800	34,200	55,600	83,900	120,000	..	..
4½-inch—Velocity in feet per second ..	3·10	4·06	4·93	6·46	7·84	9·10	10·29	11·40	..	..	..
Gallons per minute	580	1,710	3,690	10,900	23,500	42,500	69,300	104,000	..	..	..

APPENDIX V.

FLOW OF WATER IN CHANNELS.

TABLE OF VELOCITIES FOR VARYING SLOPES AND HYDRAULIC RADII—r.

V—for ordinary earth channels. V—for concrete lined channels or ordinary unplaned plank fluming.

Velocities in Feet per Second.

Radius in Feet.		Slope in Feet per Mile.												
		0·25.	0·5.	0·75.	1·0.	1·5.	2·0.	2·5.	3·0.	4·0.	5·0.	6·0.	7·0.	8·0.
0·5	Earth	·261	·330	·473	·582	·632	·723	·856	1·00	1·17	1·32	1·45	1·72	1·87
	Concrete	·465	·676	·841	·987	1·22	1·43	1·61	1·78	2·08	2·34	2·59	3·02	3·41
1·0	Earth	·416	·605	·752	·879	1·09	1·28	1·44	1·59	1·86	2·10	2·33	2·75	2·95
	Concrete	·740	1·08	1·34	1·56	1·93	2·27	2·56	2·83	3·30	3·73	4·11	4·86	5·42
1·5	Earth	·546	·793	·987	1·15	1·44	1·68	1·89	2·09	2·44	2·75	3·04	3·54	4·06
	Concrete	·971	1·41	1·76	2·05	2·55	2·98	3·36	3·71	4·34	4·89	5·40	6·29	7·11
2·0	Earth	·662	·962	1·19	1·40	1·74	2·03	2·29	2·53	2·96	3·34	3·68	4·29	4·81
	Concrete	1·18	1·71	2·12	2·49	3·10	3·62	4·08	4·50	5·26	5·93	6·54	7·64	8·62
2·5	Earth	·768	1·12	1·39	1·62	2·02	2·36	2·66	2·94	3·43	3·87	4·27	4·99	5·63
	Concrete	1·37	1·99	2·47	2·89	3·59	4·20	4·74	5·23	6·11	6·89	7·60	8·88	10·00
3·0	Earth	·866	1·26	1·57	1·83	2·28	2·67	3·01	3·32	3·88	4·38	4·83	5·64	6·36
	Concrete	1·54	2·24	2·79	3·26	4·06	4·75	5·35	5·90	6·90	7·78	8·59	10·03	11·31
3·5	Earth	·963	1·40	1·74	2·03	2·53	2·96	3·34	3·68	4·30	4·85	5·35	6·25	7·05
	Concrete	1·71	2·49	3·10	3·62	4·50	5·26	5·93	6·55	7·65	8·63	9·52	11·12	12·53
4·0	Earth	1·05	1·53	1·91	2·23	2·77	3·24	3·65	4·03	4·70	5·31	5·86	6·84	7·72
	Concrete	1·87	2·72	3·39	3·96	4·93	5·75	6·49	7·16	8·37	9·44	10·41	12·84	13·72
4·5	Earth	1·14	1·66	2·06	2·41	3·00	3·50	3·95	4·36	5·09	5·74	6·35	7·40	8·35
	Concrete	2·03	2·95	3·67	4·28	5·33	6·22	7·02	7·75	9·05	10·21	11·27	13·16	14·85
5·0	Earth	1·22	1·78	2·21	2·58	3·22	3·76	4·24	4·68	5·46	6·16	6·80	7·94	8·96
	Concrete	2·17	3·16	3·93	4·60	5·72	6·68	7·54	8·32	9·71	10·96	12·09	14·12	[illegible]

BREEDS OF PIGS.

E. J. SHELTON, H.D.A., Instructor in Pig Raising.

BERKSHIRE PIGS—THEIR SUPERIOR QUALITIES.

The British Berkshire Society, in whose herd books the leading British Berkshire breeders have for many years past registered their stud animals, has recently been engaged in a progressive movement aiming at popularising this famous old breed amongst the men engaged in pig raising the world over. Some of the special characteristics which they bring under the notice of breeders are as follows, and Berkshire breeders in Queensland would do well to note these several points and use them in advertising their stock:—

BERKSHIRES.

"Make more meat from meal than any other breed."

"They are hardy, docile, and exceptionally good mothers."

"They cross well with the best breeds, and improve the quality of the coarser ones."

"They thrive in climates as widely divergent as those of India and Canada."

"They obtain a premium from the leading bacon curers."

"They have won the Championship and Reserve Championship over all breeds in all carcase classes at Smithfield Show since their inauguration in 1904."

"They have won the Championships for the Best Pair of Pigs nineteen times (no other breed has won this more than three times)."

"They have won the Championship for the Best Single Pig nineteen times (no other breed has won this more than five times) at the thirty-seven Smithfield Shows since 1883."

"They have won the Whitley Challenge Cup for the Best Bacon Breed at the London Dairy Show. This record is unrivalled in the history of British live stock."

"The reason is: They yield more weight for age and a higher proportion of lean to fat, for a given weight, than any other breed."

Our illustration shows the superior quality of the Modern Berkshire Pig. Motto: "Breed Better Berkshires."

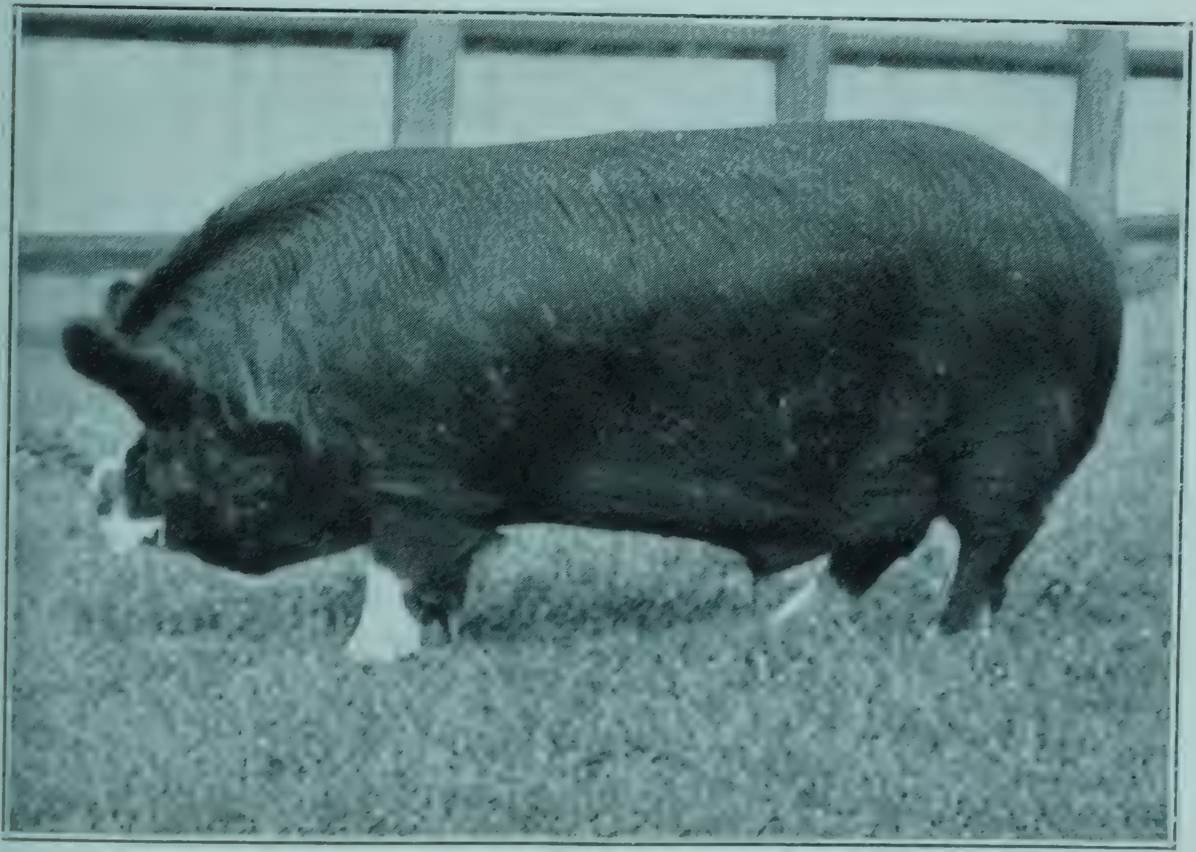

Plate 55.—"Meadow Chief."

First Prize, under 15 months; also Champion, Christchurch Show, 1922.

Bred by and the property of G. H. Barnett, Green Meadow, Leeston, Canterbury, N.Z.

PLATE 56.—"CONARGO CHOICE."
An Australian and New Zealand Champion. The property of G. H. Barnett, "Green Meadow," Leeston, Canterbury, New Zealand.

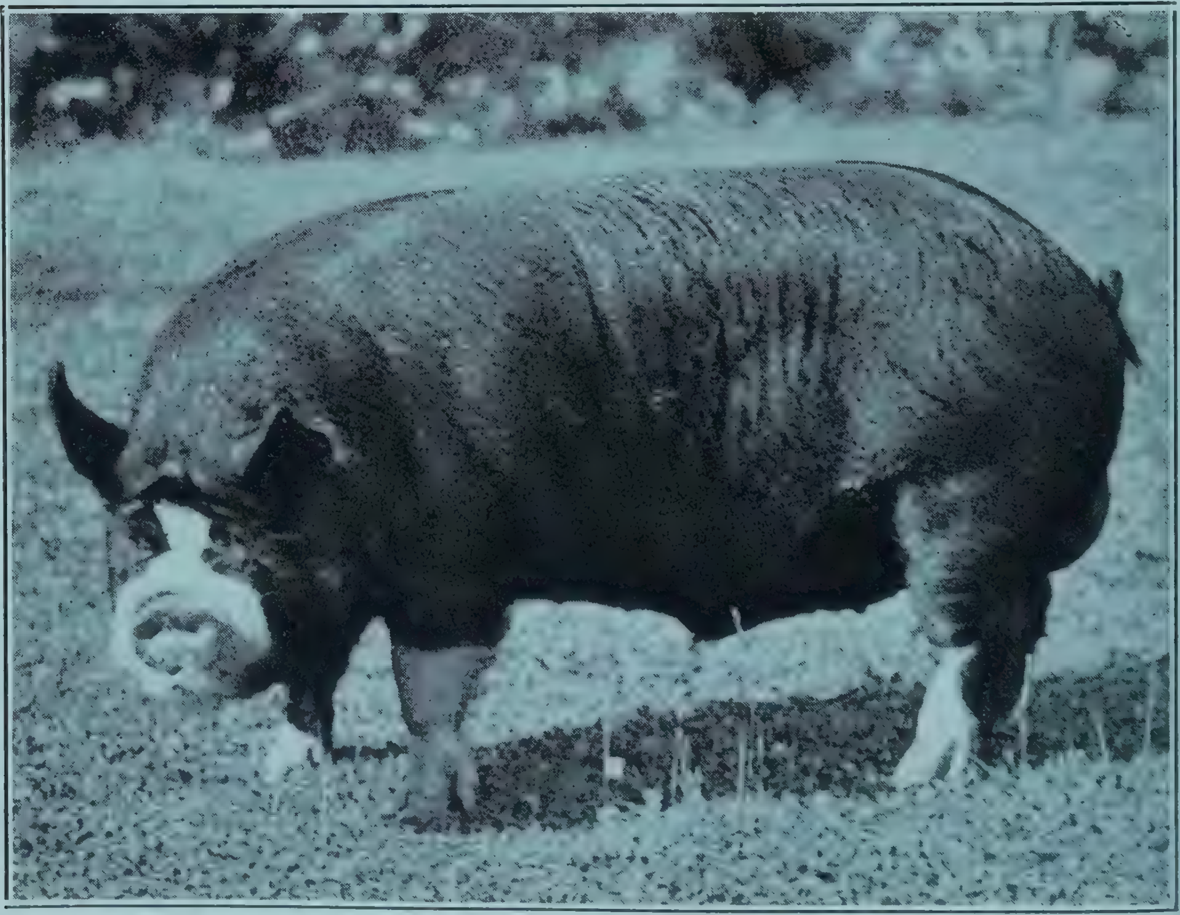

PLATE 57.—"MEADOW BRIGADIER."
A Yearling Prize-winner. The property of G. H. Barnett, "Green Meadow," Leeston, Canterbury, New Zealand.

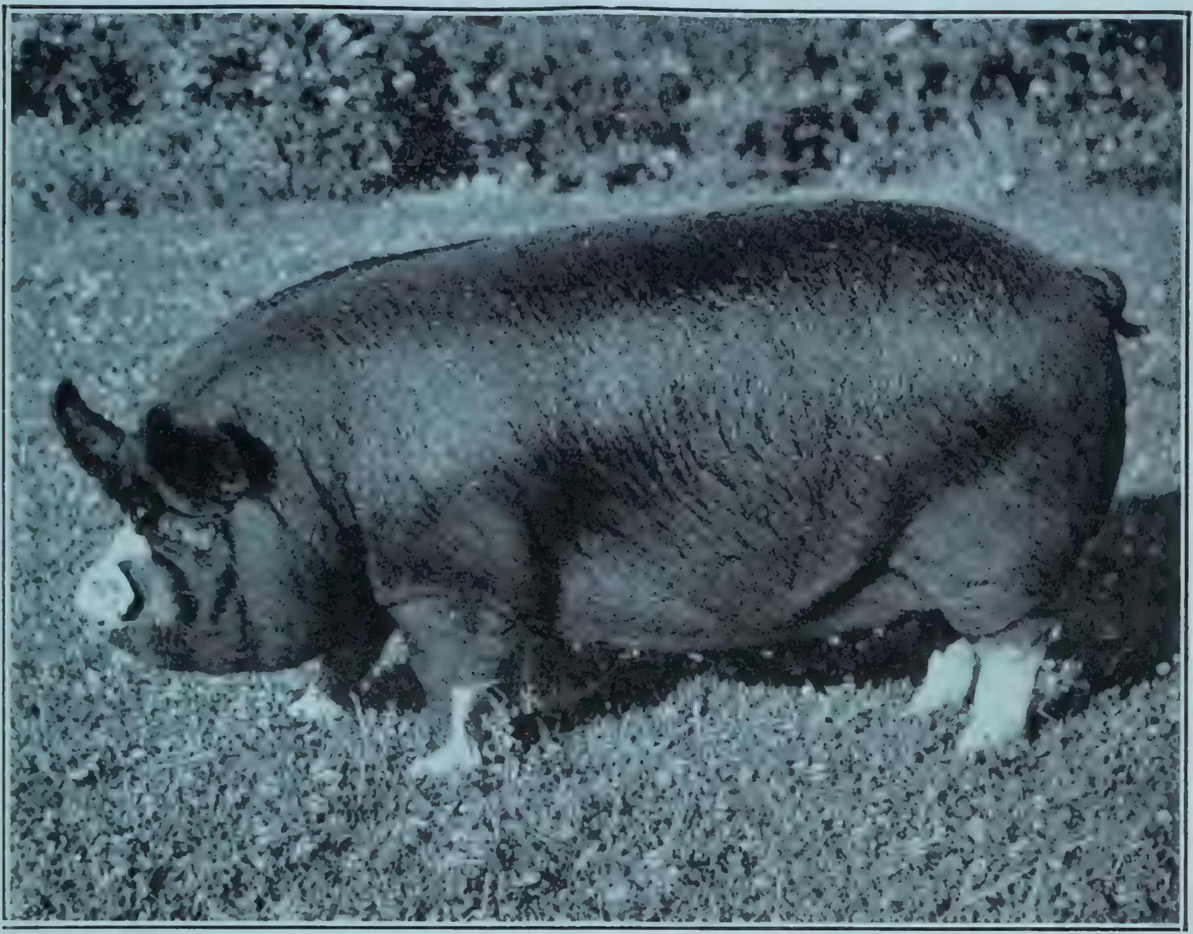

Plate 58.—"Meadow Belle."
A Prize-winning Yearling Sow. The property of G. H. Barnett, "Green Meadow," Leeston, Canterbury, New Zealand.

Plate 59.—"Meadow Queenie."
A Prize-winning Sow. The property of G. H. Barnett, "Green Meadow," Leeston, Canterbury, New Zealand.

THE BELL PIG—A PECULIAR BIRTHMARK.

The accompanying Plate illustrates a peculiar and characteristic birth-mark in some strains of the older type of Berkshire. The peculiar bell-shaped, fleshy growth under the lower jaw (the jowl) of this sow has been inherited from a line of blood, the origin of which does not appear to have been recorded.

Bell pigs were at one time common in some of the dairying districts in New South Wales, and the writer has received numerous inquiries from time to time as to their origin.

This photograph was secured through the courtesy of Mr. H. P. Jeffery, of "Greenwood," Moruya, New South Wales. On one occasion when the writer was visiting that district, the sow was then rearing a dozen hefty, vigorous suckers, every one of which had these peculiar bell-shaped growths well developed and distinct.

It would be interesting to have further information on this subject, and if any readers of the Journal have had any experience with Bell pigs the writer would be pleased to hear from them.—E. J. Shelton, H.D.A., Instructor in Pig Raising.

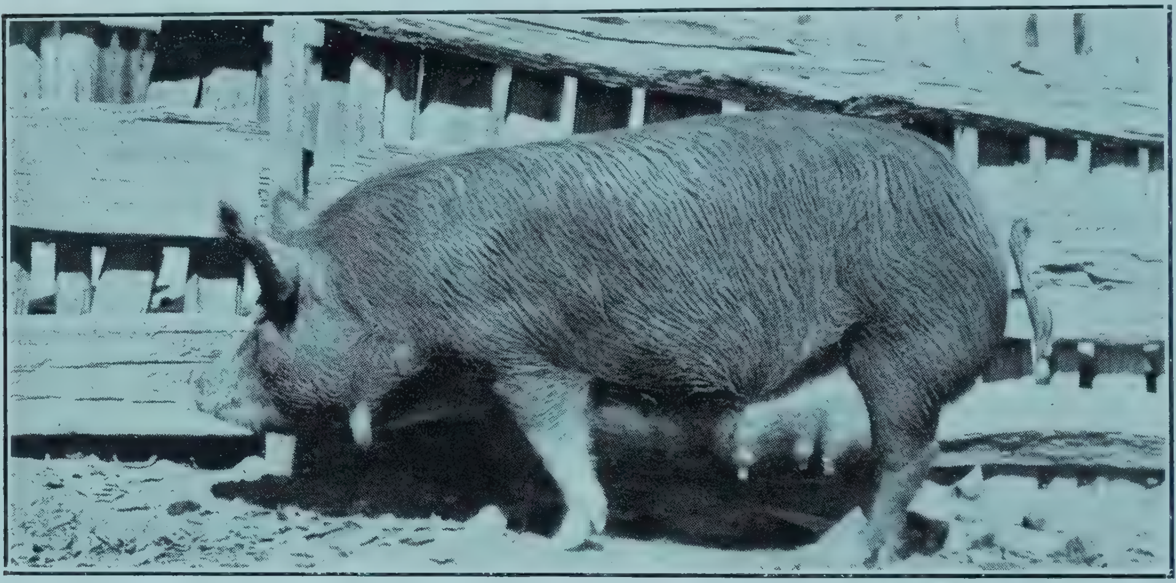

PLATE 60.—THE BELL PIG.

CARCASSES OF PIGS DAMAGED IN TRANSIT.

E. J. SHELTON, H.D.A., Instructor in Pig Raising.

The accompanying illustrations, which have been secured through the courtesy of Messrs. J. C. Hutton Limited, bacon curers, of Roma street, Brisbane, and Zillmere, depict in a striking manner one of the most serious of the losses to the bacon-curer and to the pig industry in general, as a result of careless, even brutal, handling of pigs in transit to the saleyards, in trucking, and in delivery to the bacon factory.

The pigs were originally purchased by the company as first-class baconers, for which top rates had been paid. On slaughter, however, it was found that they were damaged to such an extent through being beaten with whips and sticks, being prodded, kicked, and otherwise mauled, that their real value was reduced more than 50 per cent. They had to be converted into small goods instead of being used for first-class bacon as was originally intended.

The bruised and scarred condition of various portions of other carcasses which had likewise suffered is depicted, the bruises in many instances not showing out until curing has proceeded some time.

Bacon-curers estimate that the pig industry suffers loss to the extent of thousands of pounds annually as a result of careless handling, and it is hoped these illustrations will tend to emphasise the necessity of careful handling, and the provision of suitable saleyards in which the pigs can be handled to more advantage at point of despatch. Some country saleyards the writer has inspected are in a shocking condition; they are indirectly responsible for a good deal of the trouble referred to above.

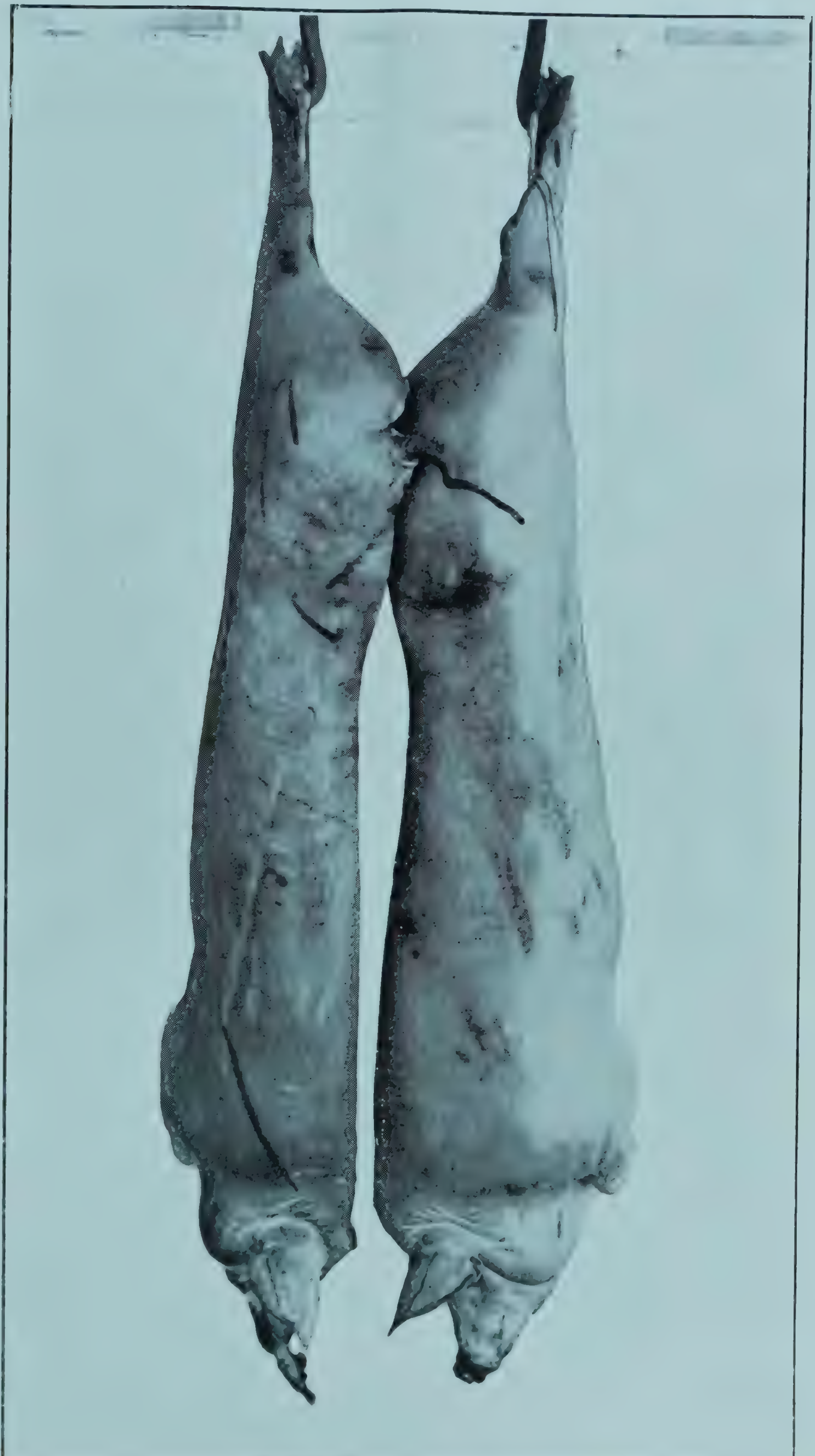

PLATE 61.

These Sides have been Bruised and Damaged to such an extent that they would be almost unsaleable in a "Fresh Meat" Market; as it is, their value to the bacon curer has been depreciated more than 50 per cent.

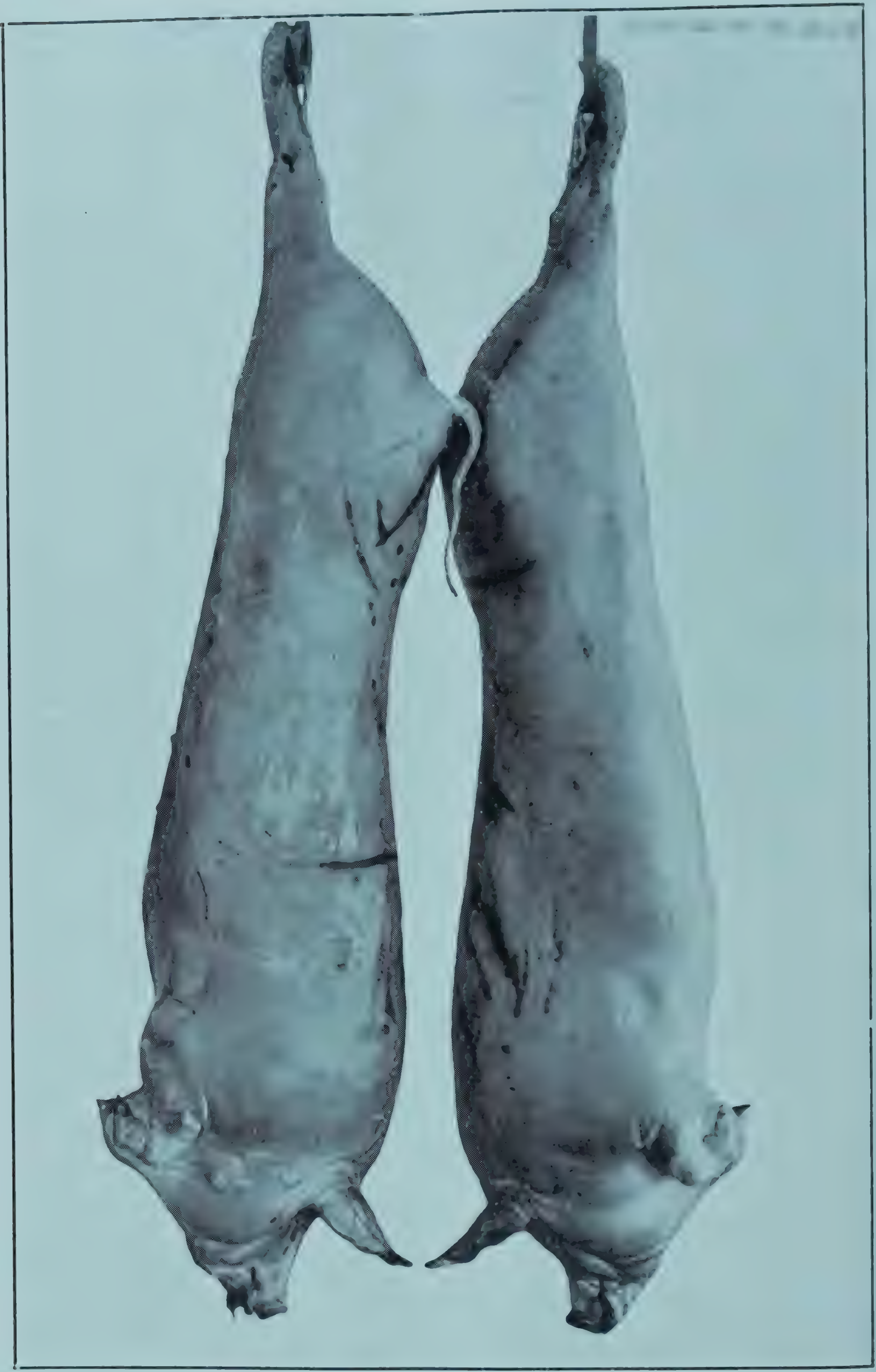

PLATE 62.
Note the bruised and scarred condition of the loin and back and disfigurement of the carcass generally.

PLATE 63.
Note the many Bruises, Cuts, and Scores on these pieces of Bacon. The result of careless handling of the Live Pigs.

FRUIT FLY INVESTIGATION.

Report of the Entomologist stationed at Stanthorpe (Mr. Hubert Jarvis) for the months, December and January, 1923-24, on the Fruit Fly and other Injurious Insects, and made available by the Minister for Agriculture and Stock (Hon. W. N. Gillies).

FRUIT FLY.

Records of Occurrence of Fruit Fly this Season.

Stanthorpe District.—The first fruit fly (as I have already stated, *vid.* Report October-November, 1923) was caught at the Summit on 30th October.

The first record obtained by me of fruit fly maggots in locally grown fruit was on 11th December, 1923.

The following are the dates of a sustained maggot infestation and the localities in which they occurred:—

Date.	District.	Fruit.	Remarks.
December 12 ..	Fletcher Siding ..	Apples ..	Eggs and Maggots
December 12 ..	The Summit ..	Peaches ..	,, ,,
December 12 ..	Applethorpe ..	Peaches ..	Maggots nearly full grown
December 12 ..	Eukey	Various Fruits	,, ,, ,,
December 12 ..	Cottonvale ..	Peaches ..	,, ,, ,,
December 13 ..	Stanthorpe ..	Apricots ..	,, ,, ,,
December 20 ..	Ballandean ..	Peaches ..	,, ,, ,,
January 7	Amiens	Apples ..	,, ,, ,,
January 14	Spring Creek ..	Peaches ..	,, ,, ,,
January 16	Glen Aplin ..	Nectarines ..	,, ,, ,,

It will be seen from the above dates (that constitute a by no means complete record) that the fruit fly was fairly evenly, although lightly, distributed throughout a large portion of the district early in December (about one month later than characterised its distribution last season).

Although only one fruit fly was caught on 30th October, it is quite possible that others were present in the district at that time though not trapped.

Outside the Stanthorpe District.

(1) *New South Wales.*—Almost simultaneously with its occurrence at the above places in the Stanthorpe district, the fruit fly (*C. tryoni*) was in the Marylands district, New South Wales (*i.e.*, 16th December) in various fruits, the maggots at that time being nearly full-grown. In fact, many had already left the fruit and entered the soil. From this fact we can conclude that the fruit fly had been operating at least twelve or fourteen days prior to 16th December in the Marylands district.

Fruit flies (*C. tryoni*) were, moreover, caught in traps at Marylands between 12th December and 16th December.

Note.—Last season the fruit fly was abundant in the Marylands and Amosfield districts some weeks before it made its appearance in the Stanthorpe orchards.

(2) *Warwick.*—Evidence of fruit fly (maggot stage) presence in loquats at Warwick was found by Instructor W. Leslie on 14th November, 1923.

(Last season they were found by myself and Mr. Perkins, B.Sc., in this fruit on 30th October.)

(3) *Toowoomba.*—Fruit fly maggots were found by Instructor W. Leslie in plums and in apricots on trees growing in Toowoomba on 22nd November, 1923.

(Last season fruit fly maggots were found by me in loquats growing at Toowoomba on 12th October.)

The foregoing records point to the fact that the fruit fly (maggot stage) this season, although about a month later, was present in certain localities outside the Granite Belt before it made its appearance in the Stanthorpe orchards; this was also the case last season.

Origin of Fruit Fly in the Stanthorpe Area.

Much has been written about the origin each spring of the fruit fly in this district. (1) Importation; (2) immigration; and (3) overwintering—have already been discussed in my previous reports (*vid.* Reports April-May 1922, June-July 1922, and August-September 1922), and each one of these three avenues, so to speak, may contribute its quota of fruit flies.

Briefly then to consider these:—

(1) *Importation.*—The danger of fruit fly importation into the Stanthorpe district was first realised by the writer on 10th October, 1922, on which date six cases of Valencia Late oranges, consigned to Stanthorpe, were found by Instructor J. Henderson and Inspector Williams to contain quantities of the maggots of the Queensland fruit fly (*C. tryoni*). Mr. Ranger, chairman of the District Fruitgrowers' Council, was at once communicated with on the discovery being made, and the maggot-infested fruit and cases were destroyed in our presence by fire.

Prior to this finding, however, many cases of oranges had been admitted to the district. (*Note.*—In no way can the inspectors be blamed for this, as it is extremely difficult, in examining consignments, to detect in any fruit the very young maggots or eggs of the fruit fly when present, and particularly so in the orange. In fact, to do this would necessitate the separate examination of each individual fruit with a magnifying glass. It is thus possible that many fruit flies may, last season, have resulted from such imported fruit.)

It was then decided to hold imported fruit at all stations throughout the Granite Belt until such fruit had been officially inspected.

This measure, however, failed to meet the situation owing to the number of stations at which the fruit was received, and to the difficulty of inspectors daily visiting these. The chief danger in this connection was the exit (which could not be obviated) of fruit fly maggots from the fruit during its detention at any of these stations while awaiting inspection.

When it was realised that the above measure had failed of its purpose, it was suggested by the writer that all fruit consigned to the Stanthorpe district should be placed in a cold chamber and subjected to a temperature of 33-35 degrees F. for not less than three weeks prior to its being sent to the Granite Belt.

The regulation under the Diseases in Plants Act embodying this suggestion came into force on 1st April, 1923, and it was hoped that this measure would prove entirely satisfactory in preventing any local importation of the living eggs and maggots of the fruit fly in citrus and other fruits subject to its attack.

This hope was not, however, realised, and failure in this respect was brought about by the following causes:—(1) Impracticability to maintain a constant temperature under Brisbane conditions of fruit cold storage; (2) difficulty of preventing fruit decay under cold-storage conditions, and temptation to make good this decay by drawing on supplies from fruit not cold-stored; and (3) difficulty of being sure of the fact of continuous cold-storage on the part of the officer issuing a certificate importing this.

Thus it was possible to find living fruit fly maggots in fruit that had been in cold storage for three weeks at a varying temperature.

This danger I first realised on 12th July, 1923, on which date living fruit fly maggots were found in imported oranges. These oranges, as was certified, had been cold-stored for three weeks at a temperature of 33-35 degrees F.

The Entomologist in Chief, Mr. H. Tryon, was at once communicated with on this discovery being made, and he immediately directed urgent attention to the matter in the proper quarter.

On 24th September, Instructor J. Henderson brought to this Office three fruit flies (*C. tryoni*) which he had bred from bananas. These bananas were imported some time in June and the flies hatched in August.

The breeding of these fruit flies from bananas was a matter of much importance, as this fruit was not included in the list of fruits to be cold stored before admittance into the Granite Belt (*vid.* Report August-September, 1923).

From that time onward to date, instances of living fruit fly maggots in various imported fruits continued to be discovered, particularly such fruits as mangoes, custard apples, papaw, and bananas. Thus it is only reasonable to conclude that many fruit flies originated in this manner and help to start the spring infestation.

(2) *Over Wintering; (a) As a pupa or adult.*—I have not yet obtained any evidence in favour of the fruit fly over-wintering (passing the winter) in this district as a pupa, and emerging in the spring by the "hatching out" of this pupa.

Experiments in 1922 and 1923 rather seem to indicate that this is not the habit of the fruit fly.

In both the abovementioned years a vigorous search was prosecuted during the winter and early spring months, in every possible situation, for fruit fly "puparia," and as a result many were found empty but none alive. Both moist and dry situations were thus examined—ones, too, under all kinds of late apples and quinces, and the soil to a depth of 12 inches put through a 1/10-inch mesh sieve. Again, the soil under various packing sheds and fruit dumps was also similarly examined. In no instance, notwithstanding this close examination, was a living pupa found at any of the above situations.

At the end of April and in May, 1923, maggot-infested fruit was placed under gauze covers and left in the open throughout the winter. In some cases these gauze covers were sheltered, and in others exposed to the frosts and weather generally.

During May many flies figuring in these experiments hatched, but none in the spring. (Examination of containers and insects of these experiments from time to time was made.) Similar infested fruit was held in the Insectary as a check in this experiment.

Records of fruit fly emergence kept by me during the months of April-May are given below:—

Host Fruit	Date of Pupation.	Date of Emergence.
Quince	5 April, 1923	13 April, 1923
Quince	5 April, 1923	16 April, 1923
Quince	..	24 April, 1923
Apple	6 April, 1923	28 April, 1923
Quince	..	30 April, 1923
Quince	2 May, 1923	7 May, 1923
Quince	3 May, 1923	10 May, 1923
Quince	May, 1923	14 May, 1923
Quince	5 May, 1923	14 May, 1923
Quince	May, 1923	17 May, 1923

One fly emerged on 25th June, 1923 (a cripple).

The above records were notes from the fruit kept in the Insectary and also from the fruit under the gauze covers abovementioned in the orchards.

Note.—It must be borne in mind, however, that any conclusions from experiments of the above nature that appear to be inevitable, might, under other seasonal conditions than those that have obtained during the last two winters, not hold good.

Experiments on the same lines will be continued this winter but on a larger scale.

Over-wintering as an Adult Fly.—Search has also been made for the adult fruit fly during the winter months, but without success.

Adult fruit flies have been kept alive for three months by me and can, it would appear, live much longer; and from general consideration I do not think it impossible for the fruit fly to survive the winter in some sheltered situation here, although I consider this very unlikely.

(3) *Immigration.*—The only other avenue by which the Stanthorpe district may obtain its fruit fly infestation is immigration, and, further, from districts outside the Granite Belt.

It is not impossible that, ordinarily, there may be immigration of the adult fruit flies over a considerable distance, especially when winds of a certain direction and the prevalence of certain flowers resorted to by the flies favour it.

The usual occurrence of the fruit fly in Toowoomba, Warwick, and Northern New South Wales prior to its appearance in this district would seem to favour this possibility.

The original scheme of research involved special experimental investigation to test this matter of immigration, but opportunity for carrying out these tests has hitherto been lacking. It is only recently that a lure really capable of attracting

the Queensland fruit fly (both sexes) has been discovered, and it is hoped by the aid of the lure, as an accessory to other procedures, to obtain some definite information in regard to this question of immigration.

The comparative freedom from fruit fly this season is a notable fact, not only in this district but also in other parts of Queensland and New South Wales.

In these other districts (both those of New South Wales and of Queensland) no special measures have been adopted either in reference to cleaning up orchards or the exclusion of maggot-infested fruit from elsewhere, so that the fly has had its usual chance to over-winter and increase. Its failure to do so is undoubtedly, therefore, largely due to seasonal conditions of a special nature.

The presence of the ''Solanum fruit fly'' in this district, early in the spring, is, I think, a fact in favour of the possibility of fruit fly immigration.

A certain lure will attract numbers of these flies (which are not of local origin) in almost any orchard throughout the district. Thus, if it is possible for this fruit fly (almost identical in structure with *C. tryoni*) to travel, it is only reasonable to concede this ability also to the latter species.

CONTROL MEASURES.

Collecting and Destroying Fly-Infested Fruit.

As has already been pointed out the most important control method, both here in Queenlsand and also in all countries where fruit flies have proved injurious to economic fruits, is the daily gathering and destruction of all ''fly-stung'' fruit, both that on the ground and also that on the tree. Where this has been consistently carried out in this district, there has been little or no loss from fruit fly attack. This fact has been repeatedly emphasised not only in my own reports, but also by every entomologist who has been engaged in fruit fly research work. Unless this ''Orchard Hygiene'' is adopted all other methods of attack or control will prove fruitless.

Poison Bait Sprays.

It is yet too early to state if spraying fruit trees carrying fruit with a poisoned sweet is of any use in controlling the Queensland fruit fly.

Several orchards have this season been consistently sprayed with the molasses and arsenate of lead bait, and these orchards so sprayed have enjoyed a comparative immunity from fruit fly attack. This partial immunity has, however, also been shared by orchards in which no poison bait spray has been used.

Isolated orchardists in this district have suffered a considerable loss from fruit fly this season, but the majority have enjoyed comparative freedom from ''fly.'' The difference in the degree of incidence of attack must be taken also into account in estimating the value of baits.

Prohibiting Fruit Remaining in the District after 7th April.

A good deal of controversy has arisen over this projected fruit fly control method suggested by Mr. A. T. Perkins, B.Sc. (Research Entomologist—The University).

It is claimed by Mr. Perkins that all fruit fly maggots entering the soil before 11th April emerge before the winter and perish, and that those entering the soil after the 11th April hibernate (*vid.* Report, Perkins, 1st October-31st December).

Records kept by me of fruit fly pupation and emergence during the month of May, 1923, do not support this. Nevertheless, I deem his suggestion a most admirable one, and well worth trying, since, apart from fruit fly control, we have much to gain by it. Even if it does not reduce the fruit fly population it will prove, or should prove, a valuable control for codling moth, which has undoubtedly been very largely increased by the practice on the part of most growers of storing late apples and other fruits also in the packing sheds. Thus, the sending of all fruit out of the district by 7th April should considerably reduce the numbers of the first (the most important) seasonal hatching of this serious fruit pest. I state ''fruit pest'' because it not only attacks pomaceous fruits but also peaches and plums.

Warwick Inspectors.

The appointment of Inspector Williams (to inspect all fruit consigned to the Stanthorpe district) at Warwick is undoubtedly a step in the right direction.

The Warwick Inspector, together with the Cold Storage Regulations, which we hope will still be maintained, should to a very large extent eliminate the danger of fruit fly introduction into the Stanthorpe district by otherwise uncontrolled traffic in fruit.

Should our annual occurrence of fruit fly in this district arise from over-wintering pupæ and from imported fruit alone (as I sincerely hope is the case, notwithstanding what has been stated now) a practical control of the fruit fly in the Stanthorpe district is within our reach, and should become assured.

OTHER INJURIOUS INSECTS.

Woolly Aphis (Natural Control Being Brought About).

The Woolly Aphis parasite, *Aphelinus mali* Hald., imported from New Zealand, 14th August, 1923, by courtesy of Dr. R. J. Tillyard, M.A., D.Sc., &c., will, I hope, become established in this district. One hundred and seven examples of this parasite were bred from the material sent me by Dr. Tillyard. These were liberated in three trees infested with Woolly Aphis; the last date on which parasites were liberated was on 28th September, 1923. From time to time the trees on which parasites had been liberated were examined, but nothing was seen of them until 20th January, 1924. On that date a large number of *Aphelinus* were discovered showing the characteristic hole made by the parasite in emerging.

Very many of these parasites must then have already hatched out and dispersed about the orchards in the Stanthorpe area, in which the majority of the first brood were liberated.

On carefully examining the apple trees in this orchard little or no Woolly Aphis was visible, so that my only fear is that the parasite may not, from lack of its host, continue to multiply.

Only one individual *Aphelinus* was recovered from twigs (bearing a few Aphids) taken from the tree on which they were first liberated and kept under conditions to admit of the obtainment of any specimens on issuing. Additional specimens will, I hope, hatch out in order to provide sufficient material to carry over the winter for use in distribution next spring.

Application has been made to Dr. Tillyard for an additional supply of the parasite to ensure its successful establishment in this district as a permanent useful endowment.

PLATE 64.—FODDER CONSERVATION.

Rhodes Grass and Sorghum Stacks on Mr. A. D. Drane's Farm.

THE UPPER BURNETT.

PROGRESS OF SETTLEMENT.

The Director of Agriculture, Mr. H. C. Quodling, in the course of a note on a recent visit to the Upper Burnett district, states that the country could not possibly look better. There is an abundance of grass everywhere, stock of all kinds look remarkably well, and at every centre along the railway line there is a marked activity and signs of renewed prosperity. At Gayndah, an average of an inch of rain per day was registered for the first eleven days in February, and this was supplemented immediately after by a general fall of between 5 and 6 inches. Following the opening of the various meatworks, fat cattle are in active demand; well-bred lines of young bullocks and steers for fattening purposes are selling well, but steers of dairying type and colour are of much lower values and hard to quit. Dairy cattle, close to profit, are in demand. Generally speaking, there is a greater activity in dairying as the result of the general rains.

New Settlers.

An influx of new settlers to the Upper Burnett is giving a fillip to business generally. At present Eidsvold is being used as the rail head, and goods and chattels for the settlers are being carried through by ballast train. The opening of the railway to general traffic, in the immediate future, will give a stronger impetus to settlement. The new settlers in the Upper Burnett area are of fine type and are fairly numerous. Temporary shacks have been hurriedly erected, fencing is going on everywhere, and a great transformation is in progress. Some settlers have already taken dairy stock right on to their blocks, and are very keen to convert the superabundant growth of natural grasses into cash. Mile after mile of the flat lands on the upper portion of the Three Moon Creek are covered with grass 4 to 5 feet in height—rich succulent Blue grass for the most part; in fact, the whole country is carrying a magnificent stand of natural grasses. With cattle on the land and motor vans for carrying cream, new settlers would be able to secure immediate returns. A good market exists for good-quality dairy cows and heifers, as most of the recently acquired selections will be used for a time at least for dairying.

Successful Demonstration Plots.

Commenting on the work carried out by the Department of Agriculture in establishing demonstration plots on areas in the Upper Burnett in advance of settlement, Mr. Quodling stated that some of the new settlers in the vicinity, whom he met, were very much impressed with the importance of the work. Many of those who settled on the scrub areas (upwards of 100,000 acres of this class of country were designed by the Lands Department for settlement) did so, after having ocular proof of the excellent growth made by the Rhodes grass on the 40-acre crop demonstration area at Monto. The crops on the Monal Creek Demonstration Farm, several miles from Monto, on the Monto-Many Peaks section of the line, looked remarkably well.

Cotton Growing.

Cotton-growing experiments have been carried out on this site. New settlers in the vicinity are taking great interest in the operations. Some excellent agricultural land exists in this locality and on the upper waters of Three Moon Creek, near Cania Station. Given a run of favourable seasons, large quantities of dairy and agricultural produce should, in the near future, find its way to Gladstone from this region. Work on the railway line over the Dawes Range from Many Peaks is well advanced, and it is expected that this section of the line will be completed before the end of the year.

BUREAU OF SUGAR EXPERIMENT STATIONS.

ENTOMOLOGICAL HINTS TO CANE GROWERS.

By EDMUND JARVIS, Entomologist, Bureau of Sugar Experiment Stations.

During ploughing operations collect the grubs when plentiful. They will be mostly those of the greyback and the smaller reddish-brown cane-beetle *Lepidiota frenchi;* the former during this month being in the second and third stages, while the latter are fully grown third-stage grubs.

Be on the watch for grubs killed by the Green Muscardine Fungus (*Metarrhizium anisopliæ*) which is usually in evidence during March and April. When attacked by this vegetable parasite the body, instead of decomposing, retains its ordinary shape, and gradually hardening turns at first white and then an olive green colour. At this stage, being filled with fungus roots, these grubs become mummified, and can be broken into pieces as if formed of dry cheese.

The sphere of usefulness of this parasite could be greatly extended if growers would collect all such green, crusted-looking grubs, break them into powder, and thoroughly mix this with about 100 times the quantity of moist finely-sifted soil. This spore-laden earth should then be sprinkled very thinly in the furrows when ploughing up any grub-infested canefields.

Keep an eye open also for dead or dying grubs exhibiting black blotches on the sides or legs. These will probably be affected by bacterial diseases, and, unlike the preceding fungus-grubs, remain quite flaccid, and eventually decompose. Growers finding evidence of such disease are asked to communicate with the Entomologist at Meringa.

Protect Your Beneficial Insects.

Do not pick up the soil-frequenting larvæ, &c., of insect friends of the cane-grower, which are parasitic or predaceous on grubs of our cane-beetles, and may be easily recognised by the following descriptions:—

(1) Plump, white, maggot-shaped inactive larvæ about an inch long, sometimes found attached to dead or dying cane-grubs. These turn into digger-wasp parasites.

(2) Dark-brown cocoons, about 1¼ inches long, with rounded ends; composed of silk hardened to the stiffness of thick paper. These contain digger-wasp parasites.

(3) White maggots, nearly 1½ inches in length, more slender than those of No. 1, and able to tunnel with ease through the soil by means of a pointed beak. These predaceous larvæ of Robber-flies pierce and suck the juices of cane-grubs.

(4) Larvæ, resembling flattened wire-worms, from 1 to 2 or more inches long, with yellowish-brown shining bodies and six small legs near the head-end. These slippery, very active creatures are predaceous on cane-grubs, &c., which they seize with sharp, sickle-shaped jaws, adapted for cutting through the skin of their unfortunate victims.

Continue to watch the growth of cane on low-lying flats where the beetle-borer (*Rhabdocnemis obscurus* has proved injurious during past seasons; and moth-borers have been observed during November and December.

''Dead-Hearts'' occurring among stools where the sticks are from 3 to 5 feet high signify the presence of caterpillars of the Large Moth Borer (*Phragmatiphila truncata*). If numerous enough to attract attention such infestation should be brought under the notice of the Entomologist ('Phone 95, Gordonvale).

Similarly, should growers discover evidence of beetle-borers commencing to attack the basal portion of cane-sticks, it would be advisable for them to seek advice before the crop becomes seriously damaged.

SCIENCE NOTES.

By EDMUND JARVIS, Entomologist, Bureau of Sugar Experiment Stations.

MELOLONTHID BEETLES AFFECTING SUGAR CANE.

The insects figured on the accompanying coloured plate, although being for the most part of minor economic interest, include at least two very destructive species (Nos. 1 and 7).

Fortunately, the grubs of *Lepidiota frenchi* Blackb., which are nearly as large and scarcely less injurious than those of our notorious greyback cane-beetle (*Lepidoderma albohirtum* Waterh.), do not damage cane-roots each season, only attaining full growth (third instar) every second year.

Although nearly twelve months of the life-cycle of *frenchi* are occupied by the first and second larval instars, the grubs do not during this period effect material injury to cane.

Both this species and *Lepidiota caudata* Blackb. (Fig. 7) are mainly destructive to roots of grasses, &c., appearing in some respects to take the place in North Queensland of some of the larger species of *Haplonycha*, two of which (*obesa* and *nigrescens*) are considered by French to be decidedly harmful to pasture land in Victoria. The grubs of *frenchi* occur freely throughout forest land in the Cairns district, subsisting largely on roots of the common "Blady Grass" (*Imperata arundinacea*); while those of *caudata*, which usually inhabit scrub lands, appear to be very partial to *Paspalum platycaule*, since out of forty-three grubs collected at random from among roots of this grass at Deeral in 1916, no less than 88 per cent. were found to be larvæ of this beetle.

Figures 8 and 9 illustrate the sexes of our so-called "Elephant Beetle," which, strictly speaking, is not a melolonthid, but a member of the family Dynastidæ.

The following brief biological notes regarding the eight species of coleoptera in question will doubtless be of interest to canegrowers.

Lepidiota frenchi Blackb. (Fig. 1).

This cockchafer appears on the wing during November or December, usually being a few days behind the greyback.

Emergence takes place at twilight (about 6.45 p.m.), when suddenly and without warning of any kind myriads of these beetles arise simultaneously from every quarter and wildly dash to and fro, thousands being in view at the one time, which, in their erratic flight constantly knock against the cane-leaves, such sudden impact being plainly audible at a distance of several yards. In addition to this oft-repeated sound the air, so still before, vibrates with a continuous humming note, due to the accumulated buzzing of countless numbers of these insects.

Upon catching one, we shall notice a faint whitish bloom over-spreading the general body colour of reddish-brown, which, looked at with a pocket lens, is at once seen to be due to the presence of numberless tiny circular white scales resting in punctures.

The outer edges of the prothorax are dark-red, turned up slightly, and symmetrically scalloped, the hind margin of same being densely bordered with these curious scales. The ventral or lower surface of the body, including the legs, is thickly clothed with white scales, which on the thoracic plates vary from circular to pear-shaped, and near the coxæ are replaced by long silvery hairs.

The four life-cycle stages (egg to beetle) have been fully described by the present writer in Bulletin No. 5, Division of Entomology, of our Sugar Bureau, so need not be given here.

Although in evidence each season, *frenchi* is only excessively abundant every second year. Some idea of their numbers at such times may be gathered from the fact that, in 1915, four beetle collectors picked off in half an hour 23 lb. of these cockchafers whilst in the act of copulation from the wire fence of Gordonvale Recreation Reserve. About 475 specimens weigh 1 lb., so that the above quantity represented no less than 10,925 beetles.

The attitude assumed while mating is rather curious, as the female alone clings to the leaf-blade or other support (not the male, as inadvertently reported in Bulletin No. 5 of this Office (page 7)), the male hanging motionless head downwards in mid air supported only by the genital organs, and with the ventral surface of its body exposed to view.

Lepidiota consobrina Gir. (Fig. 2).

Referring to the plate it will be noticed that this species closely resembles the preceding (*frenchi*) in general appearance and coloration. *Consobrina*, however, which emerges from the ground about three weeks earlier than the latter insect, is of local occurrence, much rarer on forest country, and if closely examined will be found to possess the following structural specific differences.

The Larva.—Setæ on venter of anal segment of both species arranged in the form of a pear-shaped figure, which in *consobrina* is elongated, having two parallel rows of short bristles. Width of head 7.20 mm. (in *frenchi* 5 mm.).

The Beetle.—Average length $1\frac{1}{8}$ inches; (*frenchi* 1 inch). Antennal joints, Nos. 6 and 7 in male, stouter than in female. Teeth on outer edge of front tibiæ having the points more obtuse than in *frenchi*, and not equi-distant. Front tibial spur stouter and blunter than that of *frenchi*. The ventral transverse bands of scales on abdominal segments 1 to 4, narrower on centre and sub-ventral areas than in *frenchi*.

The grubs of this species often occur under cane-stools, and in localities near scrub land where the beetles are plentiful doubtless cause serious injury to the roots.

***Lepidiota grata* Blackb. (Fig. 3).**

The only previous record of this species was published in Bulletin No. 16 of our Division of Entomology, and refers to specimens of the beetle having been sent to us from Gin Gin. We have no actual evidence, however, of its being in any way injurious to sugar-cane.

***Lepidiota rothei* Blackb. (Fig. 4).**

This dark, shining, reddish-brown beetle emerges from forest land about the same time as *frenchi,* from which it differs in being much smaller (17.50 mm.), and in having the white scales on its elytra pear-shaped instead of circular.

Although grubs of *rothei* are often found under cane, their presence is probably due in many cases to the beetles having been attracted to such spots by a thick growth of weeds between the rows.

In its habits and mode of occurrence this species closely resembles *Lepidiota frenchi,* from which, however, it differs in having a life-cycle of only one year; and in being a cane-beetle of minor economic importance.

***Lepidiota froggatti* Macl. (Fig. 5).**

Fortunately, this fine melolonthid seldom attacks cane-roots, being in fact a rather rare species. It appears to frequent scrub lands, and is believed to have a two years' life-cycle, although one cannot make a definite statement on this matter until the life-history has been worked out.

***Lepidiota* No. 215. (Fig. 6).**

A glance at the accompanying plate will show the close similarity in form and colour between this species and *rothei* (Fig. 4).

Mr. A. M. Lee, indeed, the well known Coleopterist, to whom specimens were submitted in 1916, identified this beetle as being *Lepidiota rothei,* and up to the present it has remained unnamed. However, I have no doubt about its being specifically distinct from any of our other cane-beetles. It is slightly larger and darker than *rothei,* from which it differs very noticeably in having smaller and narrower scales, the centre of the clypeus more deeply notched, the central area of the abdomen less densely scaled, and in having darker legs. In addition to the foregoing distinctions this species has a two years' life-cycle; and, moreover, its larval and pupal stages present specific distinctions not found in those of *rothei.*

***Lepidiota caudata* Blackb. (Fig 7).**

This is a very interesting cane-beetle, which in the vicinity of scrub land at Babinda and elsewhere appears on the wing during September, and in some localities is believed to be a pest of premier importance. Its grubs are about as large as those of our greyback, and able to inflict serious injury to cane roots.

Freshly emerged beetles of *caudata* have an opalescent sheen, and the dorsal surface is sparingly and minutely punctulate, the scales although circular in form being much smaller than those of *frenchi. Caudata* has a two years' life-cycle, and is said to feed on the foliage of trees belonging to the family Euphorbiacæ.

***Xylotrupes australicus* Thoms. (Fig. 8 and 9).**

The large grubs of this well known dynastid, commonly termed "Elephant Beetle," feed mostly on vegetable humus, being often found in rubbish heaps of compost or decaying vegetable matter, and during 1914 were reported as occasionally occurring in canefields.

The beetles, which are attracted to light and sometimes fly into houses at nighttime, feed on Poinciana and other trees. During 1910 I observed great numbers lying dead under several large Jacaranda trees that were growing in the courtyard of the Houses of Parliament, Brisbane.

DESCRIPTION OF PLATE.

Fig. 1. *Lepidiota frenchi* Blackb.
Fig. 2. *Lepidiota consobrina* Girault.
Fig. 3. *Lepidiota grata* Blackb.
Fig. 4. *Lepidiota rothei* Blackb.
Fig. 5. *Lepidiota froggatti* Macl.
Fig. 6. *Lepidiota* No. 215.
Fig. 7. *Lepidiota caudata* Blackb.
Fig. 8. *Xylotrupes australicus* Thoms. (female).
Fig. 9. *Xylotrupes australicus* Thoms. (male).

Del. E. Jarvis

CANE PEST COMBAT AND CONTROL.

The Director of the Bureau of Sugar Experiment Stations (Mr. H. T. Easterby) has received the following report, under date 28th February, 1924, from the Entomologist at Meringa, near Cairns (Mr. E. Jarvis).

Now that the flighting of cane-beetles has ceased, one hears on all sides such questions as the following:—"Will grubs be plentiful this season?" "What damage are they likely to do?" etc., etc.

As previously mentioned in a recent report, greyback cane-beetles appeared this season, from December to January, in considerable numbers. During the fortnight preceding oviposition 150 points of rain fell, which being accompanied by an average temperature for those fourteen days of 79.50 degrees F., including a mean maximum temperature of 89 degrees F., permitted normal development of the eggs. It is important to note also that an additional 9.17 inches were registered during the period passed in the egg stage, prior to hatching of the first-stage grubs.

We may, therefore, infer from the above facts that climatic conditions having proved very favourable to the greyback cockchafer, its grubs are likely to show up presently in great numbers.

It will be remembered that last year this pest received a severe natural check; more than 50 per cent. of the beetles having perished in the ground owing to a long-continued spell of dry weather.

As pointed out in a previous report we may, I think, expect considerable damage to cane next April, although, in all probability, the general infestation will not come up to that experienced during normal seasons, in which the rainfall in the Cairns district for the period of four months, November to February, averages 49.32 inches.

At the present time, very few grubs of *albohirtum* have entered on the second instar; as out of 116 collected on 11th February only six were found to be in the second stage. By the end of this month, however, first-stage grubs of this species should be unprocurable.

Field investigations in this connection on the above date have revealed third-stage grubs of *frenchi* feeding amongst cane-roots on fairly dry soils at depths varying from 5 to 8 inches.

Out of thirty-six stools examined by Mr. G. Bates, grubs of *frenchi* were located under fourteen, and of *albohirtum* under eleven stools, while larvæ of both those cane-beetles were found together under two stools.

Examination of the soil beneath clumps of "star grass," and of sugar grass (*Sorghum halepense* Pers.) yielded an average of about eight first-stage *albohirtum* grubs feeding at depths of from 5 to 10 inches.

Field Work.

Several experiment plots have been established this year in various localities, in order to accumulate further data in connection with the fumigant para-dichlor.; the efficiency of which as a grub destroyer was demonstrated last season at Meringa.

Present experiments are designed to determine the minimum amount of para-dichlor. required per acre to afford protection from this pest, and to kill its first and second stage grubs. It is hoped that this may be accomplished by injections of one-sixteenth of an ounce, placed 12 inches apart and 4½ inches deep.

Experimentation having been limited this season to the establishment of small plots consisting of from one-tenth to one-eighth of an acre, most of the work has been done with the "Jarvis Injector" invented for burying dry fumigants.

Machine for Para-dichlor.

Growers will be interested to learn that early this season (15th October) the writer got into touch with Massey-Harris Company, Limited, with a view to getting them to build a machine for treating large areas with para-dichlor. The requirements of such an appliance were fully described, and as a result of various suggestions the firm endeavoured to meet the situation by making certain additions and alterations to one of their corn planters.

A machine was accordingly sent to us early in January, which when tested in the field succeeded in dropping and burying uniform quantities of para-dichlor. about 2 inches deep and 15 inches apart. This was effected by the use of four circular plates pierced with holes adapted for dropping doses of one-sixteenth, one-tenth, one-eighth, and one-fourth ounce.

As a result of this field test additional improvements in construction were effected locally, under the direction of Mr. McCawley, a representative of the firm of Massey-Harris. About a week later, when treating a plot of young cane with this machine, a few extra modifications were suggested by the operator, Mr. H. Knust, as being advisable in order that it might work more freely and uniformly on roughly cultivated areas. These improvements can be simply effected, and we are not likely to find need for additional alterations. At the present time, however, the machine in question can be used for treating well-worked cane land. Possibly final alterations may be completed in time for further trials this season.

This machine will not be costly, and being of simple construction is not likely to get out of order, as most of the mechanism is open to view, easily cleaned, and works freely.

Results already obtained in this direction, however, mark a decided step forward, since with such an appliance it will be possible for one man and a horse to fumigate from 3 to 4 acres a day, thereby reducing the cost of application to a minimum.

Experiments with Calcium Cyanide.

Last August, I received a letter from the American Cyanamid Company, of New York, drawing my attention to the merits of calcium cyanide, which is being used at present for destroying rabbits, orchard pests, fleas, wireworms, &c. A sample of this insecticide has now been obtained from Buzacott and Company, Limited, of Sydney, with which initial experiments have been commenced, with a view to testing its effect on grubs of our greyback cockchafer (*Lepidoderma albohirtum* Waterh.).

The sample forwarded is that marketed as Grade B, costing about 8d. per pound, and is in the form of a dark-grey powder, which during decomposition by the moisture of the air or soil generates hydrocyanic acid and calcium hydroxide. Although very deadly, this insecticide is not dangerous to handle if reasonable precautions be observed. The hydrocyanic acid gas is given off for a period of about twenty-four hours, thus allowing time for the fumes to penetrate some distance in moist soils open for such fumigation. It is worth noting also that the residue left behind in the ground after complete evaporation of the hydrocyanic acid contains no poison, as in the case of a material like arsenic, but is simply ordinary slaked lime.

Laboratory experiments started this month (February) with caged grubs of *albohirtum* are yielding very promising results, data obtained up to the present indicating that a dose consisting of only 8 grains of calcium cyanide is sufficient to kill first-stage grubs of *albohirtum* and third-stage grubs of *frenchi* in less than twelve hours, when sprinkled about 2 inches above the level at which they are feeding, and then covered over by a couple of inches of soil. The cages of earth used in this experiment were about 4 by 3½ inches in size, and left open at the top. We have yet to determine the distance that hydrocyanic acid gas will travel vertically and horizontally on each side of 8 to 15 grain injections, and what effect it may have on growing roots of cane.

I am of opinion that the poisonous nature of calcium cyanide will not prove a serious drawback to its use in canefields, since it would not, like Paris green or lead arsenate, &c., need to be dusted through the air, but simply buried underground.

The para-dichlor. machine being now completed for us by Massey-Harris, for instance, should be just the right thing for putting in calcium cyanide. Being enclosed in an air-tight container the fumes from this insecticide could not reach the operator, who would neither see nor smell it during its application to the soil.

The granular form of calcium cyanide would probably suit our purpose better than the Grade B dust, being more convenient to handle than the latter, and perhaps evaporating over a longer period.

The price of the former, put up in 200-lb. drums, is 17½ cents per pound.

SUGAR: FIELD REPORTS.

The Acting Southern Field Assistant (Mr. A. P. Gibson) reports to the Director of Sugar Experiment Stations under date 14th February, 1924:—

Yerra.

These sugar lands are of a hilly nature, they are not extensive, nor do they raise big tonnages. The soil varies from a light brown to red in colour, overlying not at a great depth a substratum of rock or clay. Growing cane on the frosted lowlands has been abandoned, and the highland area is gradually increasing.

The principal varieties planted on the new land are Rappoe and Striped Singapore, these generally do well and are favoured partly because they cover the rows quickly. D. 1135 is mostly planted on the older areas. The cane after harvesting is carted to the Government line and railed to the Mount Bauple mill.

Childers.

The 1924 season commenced well with beneficial rains. Great activity prevails on the farms. The double-disc plough is favoured for hillside work. Hapsburg and Lynwood each have a modern set of steam ploughs at work, turning the soil up to 18 inches depth. Deep ploughing permits the plant roots to penetrate to a greater depth in the soil, thereby extending the feeding area, but the depth to which the ploughs can be used should, of course, be regulated by the natural depth of soil. It is said that these ploughs can do nearly an acre an hour under the best conditions. The majority of farmers have realised the importance of helping to restore the depleted organic matter by growing and turning in leguminous crops. This practice is indispensable. It is not correct agriculture to burn cane trash; this should be ploughed in.

The production of these volcanic red soils has been retarded by the general deficiency of moisture. Evidence of what water can do to advance the crop may be seen at present in moist places. The noisy but very useful Mynah birds is increasing rapidly in numbers, and no doubt is assisting to control insect pests, such as cattle ticks and army worms. Stormy rains have fallen, and a wonderful recovery is evident.

Booyal and Dallarnil.

These districts came on the map as cane-producing areas twelve years ago, and in the year 1917 they raised their record crop. This was the production of two years. Owing to non-crushing of mills in 1916 the cane industry languished for a while on account of dryness, frosts, and costly production, dairying and cotton taking its place. Once again it is flourishing. The Isis Central mill lately has been calling for more cane, and offered the growers upward of £10 per acre to grow cane on approved highlands. This plan has worked wonders. Everybody is now talking cane. Already it is computed that 400 acres are under cane at Dallarnil and about 500 acres at Booyal. Further areas have been felled and made ready for planting.

Scrub felling costs 40s. to 45s. per acre. Cane holing by mattock, size of hole 14 by 6 by 9, and planting sets, 3s. per 100. Approximately, 3,000 sets are planted in an acre.

The principal varieties favoured are Rappoe, Striped Singapore, and D.1135. The two first-mentioned are giving satisfaction on new grounds, the latter on older soils. The largest growers at Dallarnil are Messrs. Munt, Brookfield, and Hamilton, whose cultivations aggregate about 190 acres. A little farm well tilled is often more profitable than a neglected big one. At Booyal, Messrs. Christensen and Coleman each have 13½ acres.

Pests and Diseases.—At Dallarnil green and brown grasshoppers are eating the cane leaves leaving only the midrib in places. Mosaic is generally found surrounding a patch of Shahjahanpur No. 10 variety. Farmers should lose no time in eradicating this variety. Root disease is noticed, more especially in older stubble of Rappoe and Striped Singapore.

Report of the Northern Field Assistant (Mr. E. H. Osborn) under date 20th February, 1924:—

South Johnstone.

A very big crop should again be harvested in 1924. Practically all the South Johnstone area looks well. The red volcanic on the higher grounds, and the alluvial on the lower areas show a uniformly healthy growth. On Nos. 6 and 7 Branches the cane looks at its best, while Kalbo and No. 1 Branch also show up well. At

the latter place Mr. B. Saleras, after cutting in the early part of the season, replanted in August, and it now carries a very fair crop. On the red soil in No. 7 (Mr. F. Schroeder) some very good March-planted Badila was noticed, carrying good cane. Between Japoon and the old construction camp, at Silkwood, the crops also look well. Old residents of this part of the district consider that the cane never looked better at this period of the year.

Pests.—So far this year no grubs have appeared. Borers have not done as much damage as in former years. Probably the numerous batches of Tachinid flies liberated in different parts of the district by the Entomological Branch have helped to lessen depredations.

Diseases.—The district at present is fairly free from diseases. Leaf scald was noticed in a few places in Badila ratoons, and rather more on the greyish alluvial soils than elsewhere. Growers cannot be too careful in planting any but the very best and healthiest of seed if they wish to keep their paddocks disease free.

Mourilyan.

The local mill has crushed 89,000 tons of cane for an average c.c.s. of 15, and a value per ton of 51s. The ration of burnt cane had amounted to only 11 per cent. This speaks well for the strict control that is exercised over cutting operations, and the high c.c.s. figures give an idea of how fresh the burnt cane must be when treated. The number of tons of cane taken to make a ton of sugar were 7.

Cultivation.—Cultivation in most parts of this area is sound, the cane generally being very clean, as were also the headlands. Large quantities of manures are used, and the outlook for 1924 is promising.

Cowley Area.

Between Mourilyan and this area and in the vicinity of Spring Water, some 200 odd acres of new land have recently been put under cane, a large proportion of which was low-lying country heavily covered with black palm.

This cane is remarkably green and healthy looking and is developing heavy crops. Possibly the two last seasons offered ideal growing conditions for this class of country. At Cowley some of the recently cut ratoons (especially some 5th Badila ratoons of Mr. J. McCutcheon) look good. This has been skeleton ploughed four times and has had the benefit of manure.

In Mr. McCutcheon's case his ratooning was carried out by a Titan tractor drawing a ratooning (automatic) plough. In the hot weather then being experienced the advantage of tractor power over horse-power was very plain.

Leaf scald was noticed in some Badila cane in this neighbourhood in cane yet to be cut, and more particularly in some first and older ratoons recently cut. In some places the young stools had completely died out.

Liverpool Creek Areas.

In the area known as Clump Point, through which Kaygaro, Little and Big Maria Creeks run, there is some particularly good land. In the Silkwood, and also in the area on the south side of Liverpool Creek, there are large blocks of land that could be successfully put under cane, and would be the means of permanently settling a large population.

Babinda.

The mill had just finished a successful although very long season, having crushed 163,821 tons of cane with an average c.c.s. of 13.80, and had manufactured 21,880 tons of sugar. These figures are Australian records for tonnage of cane crushed and for quantity of sugar manufactured in one season.

Among the crops particularly noticed was a block of second Badila ratoons of Messrs. Sycamore Brothers, on Babinda Creek. A large proportion of this is fairly heavy low-lying greyish soil. As a plant crop it cut a total of 207 tons. It was then well cultivated and a deep headland drain dug to carry off any surplus waters, with the result that as first ratoon crop it yielded some 410 tons. The recently cut cane is now ratooning well. In the vicinity of Harvey's Creek (red soil) some first ratoons looked very healthy.

Leaf Scald.—In my last notes on the Babinda area it was observed that disease was showing up in quite a number of scattered parts of the area, particularly in H.Q. 426 (Clarke's Seedling) and Green Goru (24B). Now that the cane has been cut the resultant ratoons show it up also, and rather more markedly; some stools gradually withering up and some dying right out. Possibly dry weather conditions may account for this to a certain degree, but scald certainly seems to be increasing in the Babinda area.

Pests.—So far the effects of grubs have not given any cause for worry.

The Acting Southern Field Assistant (Mr. A. P. Gibson) reports (6th March, 1924):—

Mackay.

These soils are low alluvial deposits, containing decomposed granite sand, and drained principally by the very shallow Pioneer River. During heavy floods there is a probability of bank erosion. At Farleigh and Habana the country is different, being hills and valleys mostly of a volcanic nature. Owing to these lands being adjacent to the sea and only a foot above it, it is necessary to have a perfect surface drainage system; this is by no means complete on many of the holdings.

Seasonal conditions were extremely adverse, practically three waterless months had been experienced. In January only 135 points of rain were recorded at Mackay, and all surrounding observing stations reported falls far below the average; in consequence the crop was then in a very backward condition. February rains averaged at least 15 inches at the time of my visit. Moist soil conditions, in conjunction with summer heat, have stimulated the crop to such an extent that it again possesses a glorious colour and is responding vigorously, but there is much leeway to make up. The crop out as far as the Palms looks better than that surrounding Walkerston. Patches of plant cane in isolated parts are well advanced.

Cultivation.—Weeds were growing apace, and where possible are being checked by the use of a light plough, the soil subsequently being levelled by a scarifier. When this is done the season's work will be completed in many paddocks. The use of the plough should be avoided as much as possible; it severs many roots upon which the crop depends, and is obviously responsible for a temporary cessation of growth.

Farmers are breaking up land that was not possible to work before the rain fell. Tractors of various makes are coming more into use on the larger holdings.

Planting.—It is a common practice to plant two or four drills of cane in lands; by so doing surplus water is hastened away. The varieties grown are many, and are as follows:—N.G. 15 (Badila) preferred on new scrub ground, H.Q. 426 (Clark's Seedling), Q. 813, Q. 819, Cheribon, M. 1900, Malagache (M. 189) on poorer soils, Black Innes (M. 87), D. 1135, and Uba cane. About 1 ton lime and from 4 to 6 cwt. meatworks have been applied per acre, but little increase in tonnage was noted owing to protracted dryness.

Pests.—Grasshoppers and caterpillars have been eating the cane leaves. Grubs and water fowl known as Red Bill, or Coot, have been responsible for much damage. This bird generally frequents swamps, and it pecks into the stem to such a degree that it tumbles or makes unsightly holes into the heart at the leaf-sheath of young cane; a paddock of young cane at Inneston was completely destroyed by this bird. *Pentodon Australis* is here, but doing little damage; beetles were observed on the pavement in the city; they evidently were attracted by a powerful picture show light. Workers were still shaking the mealy-back cane-beetles off the trees and collecting them.

Progress.—Sarina is the home of one of the most efficient mills of the district. Plane Creek was established in the year 1896, having then 39 suppliers, to-day there are 267. Last year it crushed 45,925 tons from 4,834 acres. Its record year was 1917, when 70,000 tons were crushed, and should the present season continue favourable 60,000 may be treated. The surrounding cane areas are scattered, necessitating some 50 miles of tramways; such areas generally require more supervision and increase transportation charges. M. 1900 is the favoured cane here. The crop on the whole looked surprisingly well and was further advanced than that of Mackay. Several growers have built their own tramlines, which generally enable them to remove their crops at all times. In one instance a motor-truck tractor is used for hauling purposes. Plane Creek expects big things in the near future from Carmilla and Koumala, new districts recently opened on the Rockhampton side of Sarina. At Carmilla, there are forty-three suppliers and 4½ miles of loco. track over which the cane is railed to the Government way; Koumala, twenty-three suppliers and 2 miles of line.

Homebush cane is now railed to Rosella. The method of loading from small to big wagons is quick and interesting. A powerful self-propelling steam truck crane operates on a 4 ft. 8½ in. line, situated between the Government line and the loaded small trucks. As this moves along it raises the cane off the small trucks either in slings or by lifting the truck bodily and spilling its contents into the large wagon. Several mills are extending their tramlines to newer areas.

The Southern Field Assistant (Mr. J. C. Murray) reports (19th March, 1924:—

Woongarra.

This area has brightened up remarkably since the beginning of February. The soil is in a very moist condition and humid weather prevails. Some farmers are making the mistake of trying to operate in these wet soils. It is better to lose a little time than do this.

Cane varieties that look well are Q. 813, D. 1135, H.Q. 285 (erroneously called Nerang), Uba, and M. 1900 Seedling. Nutgrass and "white eye" are probably the worst weeds the farmers have to contend with. Apparently very little damage has been caused by insects. Isolated patches of cane are showing leaf stripe and discolouration, but no secondary symptoms of cane disease were observed.

Mary Road Area.

Settlement is extending considerably along the railway between Bundaberg and the Elliott River crossing. The soil is a good-quality forest loam, and works up to a fine tilth. Good well water is plentiful. Farther out from Bundaberg on the Elliott River a number of farms are admirably situated for irrigation.

No loss, or very little, is being caused by insect parasites on the Maryborough road area. The farms have a clean, well-tended appearance, free from noxious weeds.

Cane varieties doing well include Black Innis, M. 1900 Seedling, Q. 813, N.G. 16, and D. 1135. Of these the farmers will probably find that on this soil Black Innis, Q. 813, and D. 1135 will give them the best returns. Growers are probably aware of the fact that cane holing should be followed as soon as possible by the plough. This soil is fairly productive when ploughed, but much of this productiveness is lost if the cane is planted with the mattock.

Avondale.

The cane in this locality is making a very fine showing, both here and across the river at Moorlands. Nutgrass causes some trouble in the young plant cane, but by keeping this down in the early stages of the crops' growth the subsequent loss is slight. Canes doing well at Avondale and Moorlands are Uba, Q. 813, D. 1135, B. 208, H.Q. 285, and M. 1900 Seedling.

The texture of a heavy soil may be ruined by ploughing it when it is wet; the soil is packed into great clods which may take years to dissolve. Of the varieties growing at Avondale and Moorlands, it is probable that Q. 813 and H.Q. 285 look the best. B. 208 is making a good showing.

Springfield.

The farmers here have had very heavy rains lately; in some instances large quantities of soil have been swept down to the lower portions of the farms. The outlook is very encouraging and the harvest, provided the winter is not early, should be a reasonably good one. Farmers here are not greatly troubled by noxious weed growth or parasites, their greatest drawback being lack of rail transport. As this area is rapidly developing, both from a tourist and farming point of view, it should almost pay the authorities to extend the standard gauge from Pemberton on to the Elliot Heads. Cane varieties looking well include M. 1900 Seedling, D. 1135, and Q. 813.

The by-products of meatworks should give results in these soils. Here, as elsewhere, the farmers are advised to let their heavier soils alone while wet.

Oakwood.

Similarly with other places, the cane at Oakwood has benefited greatly by the rain. The weeds are also growing, keeping the farmers busy. Varieties that are most noticeable are E.K. 1, M. 1900 Seedling, Black Innis, Q. 112, B. 208, H.Q. 285, Q. 1098, E.K. 28, and E.K. 2. This area presents a very healthy appearance just now. Disease is absent, and there are no indications of borers or rats. Bonedust is being used with satisfactory results.

The Northern Field Assistant (Mr. E. H. Osborn) reports (20th March, 1924):—

Cairns.

Given favourable conditions from now on, large crops of cane should again be harvested by each of the local mills. Some D. 1135 first ratoons of Mr. Jno. Cannon, and some first ratoons Badila of Mr. J. Skene, at Highleigh, looked well.

At Freshwater, the cane seemed rather backward, more especially the easily-cut ratoons, but at Messrs. McManis and Painter's a 12-acre block of plant Badila looked good. These growers have just added to their already first-class plant a concrete dam, to prevent erosion caused by the Barron River during flood time.

Cane Varieties.—Several plots of the newer varieties of cane were inspected at Aloomba and Hambledon, mostly E.K. 28, H. 109, Q. 813, 7R. 428, H.Q. 458, and Q. 695. In all of these plots E.K. 28 has made good growth, both as plant and ratoons, as also has Q. 813, but at Mr. J. Smith's Hambledon Farm, Q. 695 has done the best. It struck well and shows very good growth of even-sized sticks carrying a healthy green top. The cane from which the plants were obtained did not arrow.

Diseases.—With the exception of one paddock, leaf scald did not appear as prevalent as expected. Where seen it was most apparent in N.G. 24B, N.G. 24, and H.Q. 426. Top-rot was, however, noticed, more especially in the Freshwater area, generally affecting single shoots.

H. 109 was noticed to be suffering from mosaic in several places, and it is not advisable to replant same. In the demonstration plot at the Mulgrave Central Mill evidence of leaf scald, and also mosaic, has shown up to a far greater degree than when last visited.

As mentioned previously, this plot is an example of the destruction that disease can cause, and is well worth visiting by every grower in the Cairns district.

Herbert River Areas (Macnade).

Splendid rains have fallen, freshening up the growing crops marvellously. Quite a large area of new land is included in the mill area this year. To cope with the crop a locomotive bridge has been built adjoining the one that has served the mill so long. The tramway system has also been added to considerably by extending to Gairloch, *viâ* Lily Pond, with a branch running into the new areas at Forest Home.

Victoria.

Very wet weather interfered with the time available in this part of the area, but practically the same conditions prevailed as at Macnade, except that the Ingham district had been favoured with more rain than Halifax.

Diseases.—The chief disease on the Herbert is undoubtedly "gumming," although leaf scald, leaf stripe, and mosaic are also in evidence. The situation in regard to the former is so very serious that in a circular dated 15th November last, the company state that it intends to ask the Local Cane Price Board to place Clark's Seedling (H.Q. 426) upon the list of disapproved varieties for both their mills. As this cane is grown in between a 30 per cent. and 40 per cent. proportion, it will easily be seen how serious the situation must be when such drastic steps are being considered. In the circular, it mentions that the valuable cane B. 208 was barred on the Herbert a few years ago on account of disease, and adds that even now small patches of it in the district still harbour the disease and hinder its eradication, and that it is desired to prevent the same position arising with Clark's Seedling and the gumming disease. In my previous report upon the area, leaf scald was spoken of as being seen in H.Q. 426, N.G. 15, and Korpi. The company are now exercising as close a supervision as possible over cane that is to be used for seed, any blocks that show traces of the disease spoken of being barred.

Leaf stripe was also noticed slightly in a block of first ratoons, D. 1135, that had cut about 45 tons per acre on very poor forest soil. Where this particular cane was grown the wallabies were very destructive to other varieties of cane growing alongside, but did not touch the D. 1135, much to the owner's surprise.

In the writer's opinion quite a large area of the poorer classes of land that will now probably be barred from growing H.Q. 426 would grow good crops of Q. 813, of which a fair quantity of seed should be available in the Macknade area later on.

Lower Burdekin.

Since my last visit to this district, conditions have improved wonderfully, thanks to the recent glorious rainfall, and a fair crushing seems assured. It is wonderful to note how very soon this area recovers, and gives one an idea of how fertile the Burdekin Delta would be under even ordinary weather conditions. Several blocks of healthy looking first ratoons were noticed—come H.Q. 426 of Mr. H. Wellington's, and H.Q. 426, N.G. 24 B, and N.G. 15 of the Kalamia Estate.

The former had been manured with about 5 cwt. per acre of mixed manure, whilst the Kalamia cane had two separate dressings, each of 1 cwt. per acre of nitrate of soda.

Varieties (newer).—Several small blocks of Q. 813 were noticed growing, one of the best of which was at Mr. Geo. Mackersie's at Clare. He also has some good Q. 903. Both of these canes compare very favourably with Green Goru, which he considers his best cane upon similar land. Mr. D. Ahern's (Airedale) was also seen, some uncommonly good E.K. 28 (Plant), most of which will be used for seed.

Diseases.—Leaf stripe was noticed in several blocks of B. 208 ratoons. In one badly affected paddock some stray Goru (N.G. 24) was also showing the disease. Most of the plant B. 208, however, looked right. Top rot was more in evidence this year than for the past few seasons, mostly in individual shoots. Climatic conditions are no doubt partly responsible for this.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF FEBRUARY, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALLS DURING FEBRUARY, 1924 AND 1923, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Feb.	No. of Years' Records.	Feb., 1924.	Feb., 1923.
North Coast.	In.		In.	In.
Atherton	9·46	23	4·60	3·94
Cairns	15·11	42	10·43	11·22
Cardwell	16·86	52	11·27	5·32
Cooktown	13 23	48	7·07	8·82
Herberton	7·42	37	5·20	3·74
Ingham	15·56	32	11·73	4·32
Innisfail	21·87	43	15·79	14·51
Mossman	15·61	15	8·50	8·78
Townsville	11·43	53	9·54	0·27
Central Coast.				
Ayr	8·60	37	15·69	0·12
Bowen	8·49	53	15·80	0·93
Charters Towers ..	4·30	42	13·54	0·43
Mackay	11·35	53	21·09	1·92
Proserpine	10·63	21	26·12	2·64
St. Lawrence ...	7·90	53	9·94	2·29
South Coast.				
Biggenden	3·44	25	14.81	0·41
Bundaberg	5·99	41	9·85	0·48
Brisbane	6·31	73	9·26	0·69
Childers	5·68	29	16·43	0·61
Crohamhurst ...	13·85	30	7·69	3·47
Esk	5·25	37	7·00	0·15
Gayndah	3·97	53	18·05	0·12
Gympie	6·51	54	11·10	1·48
Glasshouse Mts. ...	8·28	16	7·71	4·32
Kilkivan	4·87	45	7·83	1·65
Maryborough ...	6·44	53	10·04	5·18

Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Feb.	No. of Years' Records.	Feb., 1924.	Feb., 1923.
South Coast—continued:	In.		In.	In.
Nambour	8·71	28	8·29	5·91
Nanango	4·17	42	6 58	1 93
Rockhampton ...	7·33	37	8 31	0·42
Woodford	8·60	37	7·16	2 88
Darling Downs.				
Dalby	2·81	54	3·37	0·32
Emu Vale	2·15	28	5·99	0 00
Jimbour	2·73	36	4·51	0·03
Miles	2·57	39	8·89	0·07
Stanthorpe ...	3 21	51	4·68	0·20
Toowoomba ...	4·24	52	7·08	0 07
Warwick	3·06	59	5·08	1·10
Maranoa.				
Roma	3·01	50	8·58	1·54
State Farms, &c.				
Bungeworgorai ...	2·34	10	7·09	1·21
Gatton College ...	2·74	25	12 06	0·00
Gindie	2·82	25	8·26	0·00
Hermitage ...	2·18	18	5·67	0·00
Kairi	8·38	10	6·79	3·70
Sugar Experiment Station, Mackay	9·95	27	21·18	2·09
Warren	3·89	10	5·95	0·15

NOTE.—The averages have been compiled from official data during the periods indicated; but the totals for February, 1924, and for the same period of 1923, having been compiled from telegraphic reports, are subject to revision.

GEORGE G. BOND,
State Meteorologist.

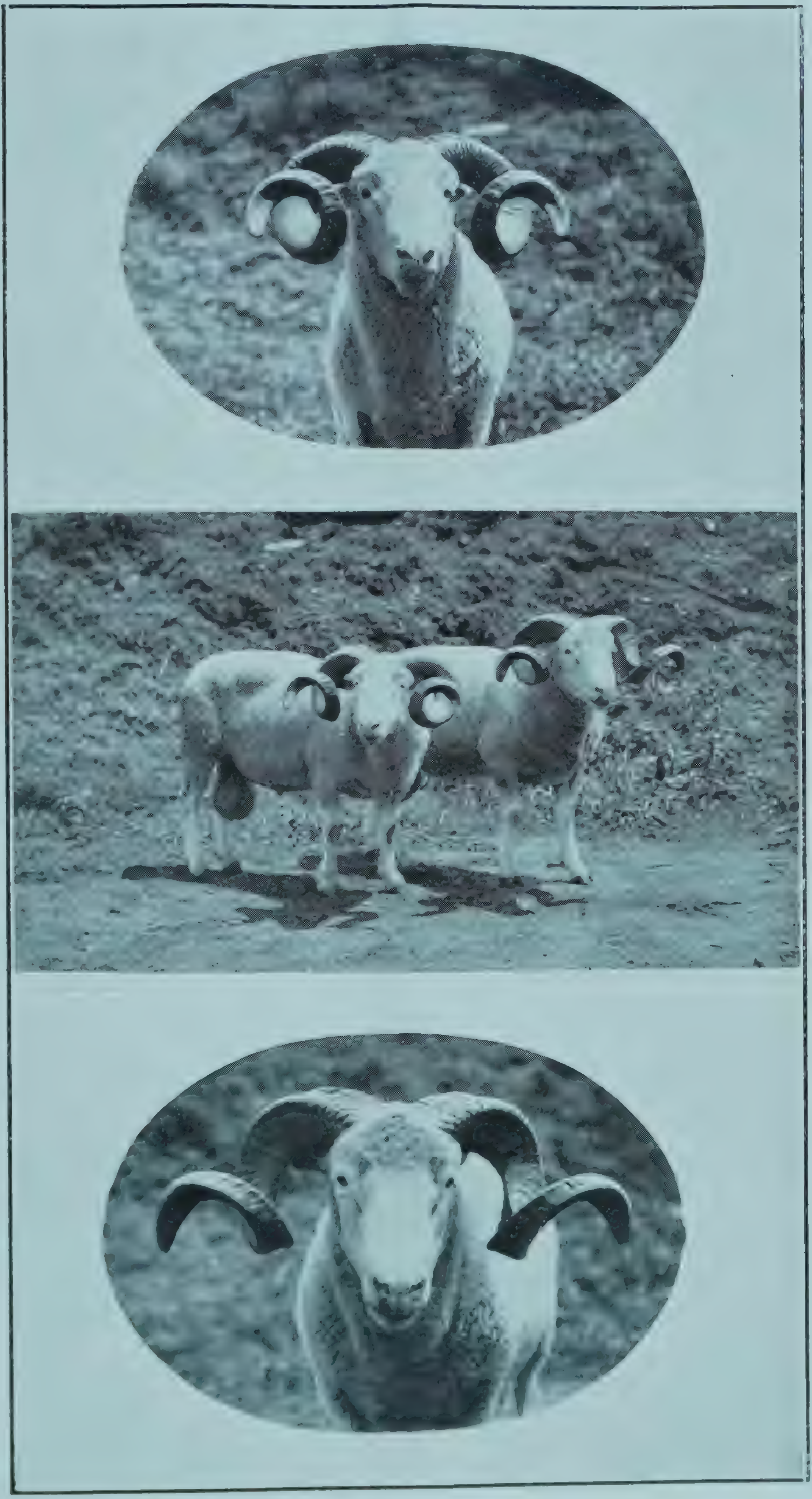

Plate 65.—Dorset Horned Sheep.

From Mr. H. McMartin's Flock, Pullen Vale, Indooroopilly, purchased by the Queensland Agricultural College Authorities for Breeding Purposes.

General Notes.

Quail Close Season.

The close season for Quails (all species) will continue until the 30th April, 1924.

Cane Prices Boards.

Representatives upon and Chairmen of the Local Sugar Cane Prices Boards have now been appointed.

Blackberry a Pest.

A Proclamation has been issued declaring the English Blackberry (*Rubus Fruticosus*) to be a pest within the Stanthorpe Fruit District.

Embargo Raised.

An Order in Council dated 24th November, 1923, prohibiting the introduction of infected or suspected stock, or any carcass of infected or suspected stock, from the State of Western Australia, has now been rescinded.

Bowen Fruit Export Society.

A notice has been issued under section 24 of "*The Primary Producers' Co-operative Associations Act of* 1923," declaring the Bowen Fruit Export Society, Limited, as a company which carries on operations of a co-operative nature in relation to primary produce under the abovementioned Act.

Staff Changes and Appointments.

Messrs. W. Long, T. Southerden, L. Southerden, D. Pope, T. Smith, R. Prest, A. M. Richardson, P. Pfrunder, J. Munro, A. Brett, R. Nelson, A. L. Teitzel, S. McCosker, D. Walker, and H. S Pratt have been appointed Inspectors under and for the purposes of "*The Diseases in Plants Act of* 1916," as from the 31st March, 1924, to the 3rd May, 1924

Police Constable H. H. Taylor, of Yaamba, has been appointed an Inspector under and for the purposes of "*The Slaughtering Act of* 1898," as from the 10th March, 1924.

Mr. R. W. Mungomery has been admitted to the professional division of the Public Service and appointed Assistant Entomologist, Sugar Experiment Stations, Department of Agriculture and Stock, with headquarters at Meringa.

Mr. C. G. Munro has been reappointed Manager, State Farm, Home Hill, as from the 24th March, 1924.

Police Constable A. F. Kahler, Mungindi, has been appointed an Inspector under and for the purposes of "*The Slaughtering Act of* 1898," as from the 10th March, 1924.

Mr. Jas. Theodore Tod, of Goomburra, has been appointed to represent the Council of Agriculture on the Cheese Board as from the 21st March, 1924, to the 30th June, 1924.

The following have been appointed members of the Arrowroot Board from the 10th March, 1924, to the 9th March, 1925:—Alexander Clark, Pimpama; Charles Daniel Gordon, Redland Bay; Alexander McGregor Henderson, Redland Bay; Johannes Lahrs, Pimpama; and Robert Stewart, Ormeau.

Police Constables J. Lane and W. Newman have been appointed Inspectors of Slaughter-houses as from the 10th March, 1924.

The Officer in Charge of Police, Eton, has been appointed an Acting Inspector of Stock as from the 10th March, 1924.

The resignation of Mr. W. Rowlands as Fruit Packing Instructor, Fruit Branch, Department of Agriculture and Stock, has been accepted as from the 29th February, 1924, such position being abolished from that date. Mr. Rowlands has now been appointed Fruit Packing and Marketing Instructor, Department of Agriculture and Stock, for a period of three years as from the 1st March, 1924.

Sugar Crop Prospects.

The Director of Sugar Experiment Stations (Mr. H. T. Easterby) recently returned from a visit to the Mackay and Bundaberg districts, and reports that the whole country along the railway line to Mackay has a splendid appearance, and grass and water are in evidence everywhere. The plentiful rains at Mackay, extending over six or seven weeks, have produced a marvellous transformation in the cane crops. A good crop is now assured, while an excellent one is possible if conditions remain favourable. The present estimate for this district is about 45,000 tons of sugar. Conditions at Bundaberg are extremely promising for a good yield, and cane has made fine progress during the past few weeks. Cane in the Woongarra sub-district, which was well behind the rest of the district, has now recovered and a fine crop is anticipated. Reports from the Childers and Nambour districts also indicate very favourable prospects for this year's crushing.

Banana Grades.

Schedule 3 (relating to the grade standard of Cavandish bananas) of the "Fruit and Vegetable Grading and Packing Regulations of 1922" under "*The Fruit Cases Acts*, 1912-1922" has been deleted, and a Schedule substituted therefor, providing that—

"Choice" shall mean sound fruit, free from blemish and properly packed, having a minimum length of eight inches and a minimum circumference of five inches.

"Firsts" shall mean sound fruit, properly packed, having a minimum length of over seven inches to eight inches and a minimum circumference of four inches.

"Seconds" shall mean sound fruit, properly packed, having a minimum length of five and a-half inches to seven inches and a minimum circumference of four inches.

All measurements for length are to be taken on the outside of the curve from the junction of the fruit at the stem-end to the top of the fruit.

Cotton Crop Prospects.

About 62,000 acres are under cotton in Queensland, compared with 30,000 acres last year. The crop this season, it is estimated, will be worth about £1,000,000.

The Acting Premier and Minister for Agriculture (Hon. W. N. Gillies), in the course of a recent Press announcement, stated that an attempt had been made this year by the Department of Agriculture and Stock to get out a reliable forecast indicating the acreage which had been cultivated under cotton, and which will be picked during the present season. A special card was issued to 9,281 growers in the course of the month of January. On these cards growers were asked to complete two statements—one showing the acreage which each grower expects to harvest, and the second one whether the prospects are for a good, fair, or poor crop. Replies have been received from 6,499 growers, and disclosed a planted acreage of 50,063 acres. Approximately 30 per cent of the growers to whom cards were sent have not yet replied. It would seem safe, however, to make an allowance for an additional quarter increase in area, which would bring the estimated area under crop to about 62,000 acres, since it must be remembered that many people had planted last year's seed.

"As to the future prospects of the crop," said Mr. Gillies, "it is as yet too early to comment. The early sown crop is generally good, but in many parts the crop is late owing to the delayed arrival of the spring rains and the dry subsoil at the time. As a result planting could not be done at the right time. These late crops have, in many cases, also suffered from the depredations of the maize grub and other insect pests, and so a great deal will depend on the weather during the rest of the season. The early arrival of frost will depreciate the crop, whereas if the cool weather holds off the late pickings will be materially increased."

Opossums and Native Bears Protected.

The Acting Premier and Minister for Agriculture (Hon. W. N. Gillies) has announced the Cabinet's decision to the effect that there will be no open season this year for either opossums or native bears. Before submitting the matter to the Cabinet he had caused inquiries to be made throughout the whole of the State. In all 243 separate reports were received from stock inspectors, dairy inspectors, Crown land rangers, foresters, and officers in charge of police from all over Queensland. Of these reports a great number indicated that it would be very unwise to open the season this year, as opossums had suffered a very severe onslaught in the 1922-23 open season. To such an extent had their number been reduced that they were in danger of extinction in very many districts where they were formerly quite numerous. In 1922, over a million opossum skins were marketed in this State, and in 1923 the number was 1,200,000. In addition to these there must have been hundreds of thousands of young ones killed, whose skins were of no commercial value. In a few isolated localities opossums are still fairly numerous, but it would be quite impracticable to open the season in these particular sections and not for the rest of the State.

Reports in favour of the further protection of the native bears were even more unanimous. Taking the value of the skins at, say, 5s., the economic worth of opossums and native bears to the State is apparent. This value would be easily jeopardised were the season to be opened regularly every year; more especially as when once an opening is announced it is extremely difficult to keep trappers within the limits of the open period.

Another reason influencing the Cabinet in its decision was the fact that by keeping the season closed this year, the prices for skins in the future are likely to be considerably improved, as there are at present enormous numbers of opossum skins awaiting sale on the American and European markets. When these have been absorbed future values will be naturally enhanced.

Co-operative Associations Act—Additional Regulations.

Additional regulations under "*The Primary Producers' Co-operative Associations Act of* 1923" have been issued which provide for, in accordance with the Act, the registration of Associations or Federations (fee, 10s.).

Forms of application will, in due course, be sent by the Registrar of Primary Producers' Co-operative Associations to the various Associations who have already applied for registration under the Act, and to others who in the future apply for registration; also for the registration of Secretaries, Treasurers, and Directors of Associations; the registration of amendments of Rules of Associations from time to time; the licensing of Auditors; the cancellation of registration of Associations or licenses of Auditors when deemed necessary for the exemption, withdrawal, or dissolution of Associations; exempting Associations or Companies from the operations of the Act by the Governor in Council on the recommendation of the Council of Agriculture; and the Scale of Fees.

Cotton Grades and Rates.

The guaranteed rates for all grades for the 1924 season are tabulated as follows:—

Grade.	$1\frac{1}{4}$ in. staple and over.	Less than $1\frac{1}{4}$ in.
A	$5\frac{1}{2}$d. per lb.	5d. per lb.
B	$5\frac{1}{2}$d. per lb.	5d. per lb.
C	$5\frac{1}{2}$d. per lb.	5d. per lb.
D	$5\frac{1}{2}$d. per lb.	5d. per lb.
E	5d. per lb.	$4\frac{1}{2}$d. per lb.
F	$4\frac{1}{2}$d. per lb.	4d. per lb.
G	4d. per lb.	$3\frac{1}{2}$d. per lb.
IMMATURE GRADES.		
1X	$5\frac{1}{2}$d. per lb.	5d. per lb.
2X	5d. per lb.	$4\frac{1}{2}$d. per lb.
3X	4d. per lb.	$3\frac{1}{2}$d. per lb.

Farm and Garden Notes for May.

FIELD.—May is usually a busy month with the farmer—more particularly the wheatgrower, with whom the final preparation of his land prior to sowing is the one important operation. Late maturing varieties should be in the ground by the middle of the month at the latest.

Cleveland, intended primarily for feeding off, should be sown not later than the end of April.

The necessity of pickling all wheat intended for sowing purposes is again emphasised; and for general purposes, combined with economy in cost of material, the bluestone and lime solution holds its own. To those who desire an easier but somewhat more costly method of treatment, carbonate of copper at the rate of 1 oz. to the bushel and used in a dry form is suggested.

Potatoes, which is many districts are still somewhat backward, should have by this time received their final cultivation and hilling-up.

The sowing of prairie grass on scrub areas may be continued, but should be finished this month. This is an excellent winter grass, and does well in many parts of Southern Queensland.

Root crops, sowings of which were made during April, should now receive special attention in the matter of thinning out and keeping the soil surface well tilled to prevent undue evaporation of moisture.

Every effort should be made to secure sufficient supplies of fodder for stock during the winter, conserved either in the form of silage or hay.

Cotton crops are now fast approaching the final stages of harvesting. Growers are advised that all cotton in the Central District should be consigned to the Australian Cotton-growing Association, Rockhampton; whilst those in the Southern areas should consign their cotton to the Association at Whinstanes, Brisbane. All bags should be legibly branded with the owners' initials. In this matter the consignor is usually most careless, causing much delay and trouble in identifying parcels, which are frequently received minus the address labels.

KITCHEN GARDEN.—Onions which have been planted in seed beds may now be transplanted. The ground should long since have been thoroughly cleaned, pulverised, and should be rolled previous to transplanting. Onions may still be sown in the open on clean and well-prepared ground. In favourable weather plant out cabbages, lettuce, leeks, beetroot, endive, &c. Sowings may also be made of all these as well as of peas, broad beans, khol-rabi, radishes, spinach, turnips, parsnips, and carrots, and, where sufficiently large enough, thinned out. Dig and prepare beds for asparagus, using plenty of well-rotted farmyard manure.

FLOWER GARDEN.—Planting and transplanting may be carried out simultaneously during this month in showery weather; the plants will thus be fully established before the early frosts set in. Camellias and gardenias may be safely transplanted, also such soft-wooded plants as verbenas, petunias, pentstemons, heliotrope, &c. Cut back and prune all trees and shrubs ready for digging. Dahlia roots should be taken up and placed in a shady situation out of doors. Plant bulbs, such as anemones, ranunculus, snowflakes, freesias, ixias, watsonias, iris, narcissus, daffodils, &c. Tulips will not suit the Queensland climate, but hyacinths may be tried, although success is doubtful. All shades and screens may now be removed to enable the plants to get the full benefit of the air. Fork in the mulching, and keep the walks free from weeds. Clip hedges and edgings.

Orchard Notes for May.

THE COAST DISTRICTS.

In these notes for the past two months the attention of citrus-growers has been called to the extreme importance of their taking every possible care in gathering, handling, packing, and marketing, as the heavy losses that frequently occur in Southern shipments can only be prevented by so treating the fruit that it is not bruised or otherwise injured. It has been pointed out that no citrus fruit in which the skin is perfect and free from injury of any kind can become specked or blue-mouldy, as the fungus causing the trouble cannot obtain an entry into any fruit in which the skin is intact. Growers are, therefore, again warned of the risk they run by sending blemished fruit South, and are urged to exercise the greatest care in the handling of their fruit. No sounder advice has been given in these notes than that dealing with the gathering, handling, grading, packing, and marketing, not only of citrus, but of all other classes of fruit.

It is equally as important to know how to dispose of fruit to the best advantage as it is to know how to grow it. To say the least, it is very bad business to go to the expense of planting and caring for an orchard until it becomes productive and then neglect to take the necessary care in the marketing of the resultant crop. Main crop lemons should be cut and cured now, instead of being allowed to remain on the tree to develop thick skins and coarseness. As soon as the fruit shows the first signs of colour or is large enough to cure down to about from $2\frac{1}{4}$ to $2\frac{1}{2}$ in. in diameter, it should be picked, care being taken to handle it very gently, as the secret of successfully curing and keeping this fruit is to see that the skin is not injured in the slightest, as even very slight injuries induce decay or specking. All citrus fruits must be sweated for at least seven days before being sent to the Southern States, as this permits of the majority of specky or fly-infested fruits being rejected. Citrus trees may be planted during this month, provided the land has been properly prepared and is in a fit state to receive them; if not, it is better to delay the planting till the land is right.

In planting, always see that the ground immediately below the base of the tree is well broken up, so that the main roots can penetrate deeply into the soil and not run on the surface. If this is done and the trees are planted so that the roots are given a downward tendency, and all roots tending to grow on or near the surface are removed, the tree will have a much better hold of the soil and, owing to the absence of purely surface roots, the land can be kept well and deeply cultivated, and be thus able to retain an adequate supply of moisture in dry periods. Do not forget to prune well back when planting, or to cut away all broken roots.

All orchards, pineapple and banana plantations should be kept clean and free from all weed growth, and the soil should be well worked so as to retain moisture.

Custard apples will be coming forward in quantity, and the greatest care should be taken to see that they are properly graded and packed for the Southern markets, only one layer of one sized fruit being packed in the special cases provided for this fruit—cases which permit of the packing of fruit ranging from 4 to 6 in. in diameter in a single layer.

Slowly acting manures—such as meatworks manures—may be applied to orchards and vineyards during the month; and lime can be applied where necessary. Land intended for planting with pineapples or bananas during the coming spring can be got ready now, as, in the case of pineapples, it is a good plan to allow the land to lie fallow and sweeten for some time before planting; and, in the case of bananas, scrub fallen now gets a good chance of drying thoroughly before it is fired in spring, a good burn being thus secured.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

Clean up all orchards and vineyards, destroy all weeds and rubbish likely to harbour fruit pests of any kind, and keep the surface of the soil well stirred, so as to give birds and predaceous insects every chance to destroy any fruit fly pupæ which may be harbouring in the soil. If this is done, many pests that would otherwise find shelter and thus be able to live through the winter will be exposed to both natural enemies and cold.

Further, it is a good plan to clean up the land before pruning takes place as, if delayed till the pruning has been finished, the land is apt to dry out in a droughty season.

Pruning can be started on such varieties as have shed their leaves towards the end of the month, as it is a good plan to get this work through as early in the season as possible, instead of putting it off until spring. Early-pruned trees develop their buds better than those pruned late in the season. These remarks refer to trees—*not vines*, as the later vines are pruned in the season the better in the Granite Belt District, as late pruned vines stand a better chance to escape injury by late spring frosts.

All worthless, badly diseased, or worn-out trees that are no longer profitable, and which are not worth working over, should be taken out now and burnt, as they are only a menace and a harbour for pests.

Land intended for planting should be got ready as soon as possible, as, if ploughed up roughly and allowed to remain exposed to the winter frosts, it will become sweetened and the trees planted in it will come away much better than if set out in raw land. In any case the land must be properly prepared, for once the trees are planted it is a difficult matter to get the whole of the land as well worked as is possible prior to planting.

Slowly acting manures—such as ground island phosphates or basic phosphates—may be applied to orchards and vineyards. They are not easily washed out of the soil, and will become slowly available and thus ready for the use of the trees or vines during their spring growth. Lime may also be applied where necessary.

This is a good time to attend to any drains—surface, cut-off, or underground. The two former should be cleaned out, and in the case of the latter all outlets should be examined to see that they are quite clear and that there is a good getaway for the drainage water. New drains may also be put in where required.

In the warmer parts citrus fruits will be ready for marketing, and lemons ready for cutting and curing. The same advice that has been given with respect to coast-grown fruit applies equally to that grown inland; and growers will find that carefui handling of the fruit will pay them well. Lemons grown inland are, as a rule, of superior quality to those grown on the coast, but are apt to become too large if left too long on the trees, so it is advisable to cut and cure them as soon as they are ready. If this is done and they are properly handled, they may be kept for months, and will be equal to any that are imported.

If the weather is very dry, citrus trees may require an irrigation, but, unless the trees are showing signs of distress, it is better to depend on the cultivation of the soil to retain the necessary moisture, as the application of water now is apt to cause the fruit to become soft and puffy, so that it will not keep or carry well.

Land intended for new orchards should be got ready at once, as it is advisable to plant fairly early in the season in order that the trees may become established before the weather again becomes hot and dry. If the ground is dry at the time of planting, set the trees in the usual manner and cover the roots with a little soil; then give them a good soaking; and when the water has soaked into the soil, fill the hole with dry soil. This is much better than surface watering.

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON, F.R.A.S.

TIMES OF SUNRISE AND SUNSET.

AT WARWICK.

1924.	APRIL.		MAY.		JUNE.	
Date.	Rises.	Sets.	Rises.	Sets.	Rises.	Sets.
1	6·4	5·48	6 20	5·18	6·37	5·2
2	6·4	5·47	6 21	5·17	6 38	5·2
3	6 5	5·46	6·21	5·16	6 38	5·2
4	6·5	5·45	6·22	5·15	6·39	5 1
5	6 6	5·44	6 22	5·11	6 39	5·1
6	6 6	5·43	6·23	5·13	6·40	5·1
7	6·7	5 42	6 23	5·13	6·40	5·1
8	6 7	5 41	6 24	5·12	6·41	5·1
9	6 8	5·40	6·24	5 12	6·41	5·1
10	6 8	5·39	6 25	5·11	6·41	5·1
11	6 9	5·37	6 26	5·11	6 42	5 1
12	6 9	5·36	6 26	5·10	6·42	5 1
13	6·10	5 35	6 27	5·10	6 42	5·1
14	6·10	5·34	6·27	5·9	6·42	5 2
15	6·11	5 32	6·28	5·8	6·43	5·2
16	6·11	5 31	6·29	5·8	6·43	5·2
17	6 12	5 30	6·29	5·7	6·43	5·2
18	6 12	5·29	6·30	5·7	6·43	5·2
19	6 13	5·28	6·30	5·6	6 44	5 2
20	6·14	5·27	6 31	5·6	6·44	5·2
21	6·14	5·26	6 31	5·5	6·44	5 2
22	6·15	5 25	6·32	5·5	6·44	5 3
23	6·15	5·24	6·32	5·4	6·44	5 3
24	6·16	5 23	6·33	5·4	6·45	5·3
25	6 17	5·22	6·34	5·4	6·45	5·4
26	6·17	5 21	6·34	5·3	6·45	5 4
27	6·18	5·21	6·35	5·3	6 45	5·4
28	6 18	5·20	6 35	5·3	6·45	5·5
29	6·19	5·20	6·36	5·3	6·45	5·5
30	6·20	5·19	6·36	5 2	6·46	5·6
31	...	...	6·37	5·2	...	...

Phases of the Moon, Occultations, &c.

The times stated are for Queensland, New South Wales, Victoria, and Tasmania, when "Summer" Time is not used.

4 Apr.	●	New Moon	5 17 p.m.
12 ,,	☾	First Quarter	9 12 p.m.
20 ,,	○	Full Moon	12 10 a.m.
26 ,,	☽	Last Quarter	2 28 p.m.

Apogee 9th April, 1·12 a.m.
Perigee 21st April, 6·18 a.m.

On 8th April, between 2 and 3 p.m., the planet Venus will be very near the moon, on its left hand side. The moon will occult it by passing between the earth and the planet before 4 p.m. This should be an interesting spectacle, especially to those who have a telescope or binoculars; even without, the planet should be visible.

On 14th April, the moon will occult Regulus, the brightest star of Leo, between 6 and 7 p.m. The emergence of the planet soon after seven may be observed with binoculars.

The occultation of Uranus on the 29th, about 2 p.m., will be only visible in a telescope.

4 May	●	New Moon	9 0 a.m.
12 ,,	☾	First Quarter	12 13 p.m.
19 ,,	○	Full Moon	7 52 a.m.
26 ,,	☽	Last Quarter	12 16 a.m.

Apogee 6th May, 12·0 noon.
Perigee 19th May, 3·18 p.m.

Regulus will again be occulted by the moon about 3 o'clock in the morning of the 13th of May.

The great astronomical event of May is the transit of Mercury, on the 8th, when the planet passing between the earth and the sun, will cross the sun's face from right to left, but in an upward direction. The commencement of the transit will be at 7·47 a.m. when the planet will reach the lower edge of the sun's disc. It's slow progress will continue until 3·35 p.m. when the sun's opposite limit will be considerably inclined over to the west.

Great care must be taken when attempting to look at the sun that the eyes are protected *very* carefully by *very* dark-coloured or smoked glass.

3 June	●	New Moon	12 33 a.m.
10 ,,	☾	First Quarter	11 36 p.m.
17 ,,	○	Full Moon	2 41 p.m.
24 ,,	☽	Last Quarter	12 16 p.m.

Apogee 2nd June, 3·24 p.m.
Also Apogee 29th June, 9·24 p.m.
Perigee 17th June, 1·6 p.m.

The planet Mercury will be a morning star in June being at its greatest distance, west of the sun, on the 4th.

After Mercury being a morning star, Jupiter will be an evening star, rising, in the early part of the month, somewhere about the time of sunset.

Saturn being in conjunction with the moon on 12th of June, will appear about 2 p.m. on the left of the moon, but somewhat higher during the evening hours.

On 16th June, Mercury will be above the moon, distant about eight times its diameter, about 7 p.m.

On 22nd June, The Solstice, the sun, when having reached its furthest northern point in the sky, appears to stand still before turning southwards.

Saturn, on 30th June, will appear stationary, after which it will appear to be moving again east in its normal direction.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S., add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhere about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

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QUEENSLAND AGRICULTURAL JOURNAL

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Event and Comment.

The Current Issue.

Special features of this issue include a paper on the geographical distribution of cotton which was read recently by Mr. G. Evans, Director of Cotton Culture, before the Royal Geographical Society of Queensland; notes on sheep and soil by Mr. Brünnich; a survey of sugar pests and diseases in the Mackay district by Mr. Cottrell Dormer; and Mr. Froggatt's sixth progress report on the banana weevil borer. This month Mr. Shelton describes the Duroc-Jersey pig. A noticeable curtailment of some of the regular features is due to pressure on space.

A Tractor School for Farmers.

A difficulty in the way of the more general use of tractors on the farm is lack of mechanical knowledge, to which is often added a feeling of uncertainty as to one's ability to operate a tractor successfully. With horses a farmer is, of course, fully confident, but the apparent complexity of a tractor often induces a feeling that without mechanical training it would be unwise to invest good money in an expensive machine. To overcome this difficulty, the authorities of the Queensland Agricultural High School and College have arranged a tractor school for farmers, commencing on Tuesday, 24th June, and closing on 5th July. A fee of £2 10s. has been fixed for the course. This fee will cover board and lodging for the period, as well as the cost of instruction. Farmers travelling to and from the school will also have the benefit of concession railway fares. The course will comprise simple talks by experts on the economics, technicalities, and operation of tractor and farm implements and machinery with which tractors are ordinarily associated in field work. Practical demonstrations and field work will also be included. Lantern lectures on general subjects will be a feature of the evening gatherings at the school. No farmer who can possibly attend the school should miss such a unique and valuable opportunity of acquiring a sound working knowledge of modern agricultural machinery and its operation in the field.

Agricultural Ministers in Conference.

Interviewed on his return recently from Sydney, the Acting Premier and Minister for Agriculture (Hon. W. N. Gillies) said that Conferences of Ministers of Agriculture, such as the one which he had just attended, were held annually, with the exception of the years covering the duration of the war. Their principal objects are a better understanding between the various State Governments in respect to uniformity in legislation and administration on matters of common interest affecting interstate

trade in primary produce, diseases in plants, fruit, stock, border restrictions, quarantine, uniform grading and marking, export trade, and tariff protection. At the recent conference the fruit industry and dairying received special attention.

Retention of the Banana Duty.

On a question raised by New South Wales for protection on dried fruits, Mr. Gillies made out a good case for the retention of the banana duty, pointing out that the industry was worth nearly three-quarters of a million sterling annually, while it was the best closer settlement industry in the north of New South Wales and Queensland, a white man's industry in which 16,000 whites are engaged directly, and many more indirectly, whereas in Fiji the whole white population is very much fewer than the number engaged in the single Australian industry. There, black labour is employed at about 2s. 6d. per day. He also stated that, after reading Dr. Darnell-Smith's report, there was very little doubt in his mind that Bunchy Top, which had existed in Fiji for thirty years, came to Australia from those islands, and he urged this as a strong reason for the retention of the tariff. The conference, on his motion, affirmed the principle of application and maintenance of tariff protection for all commodities which are or can be produced within Australia in quantities sufficient to meet Australian requirements.

Organised Marketing.

The main question discussed by the conference, which has already received some publicity in the Press, was that on the marketing of primary products, and on this subject Mr. Gillies pointed out how necessary it is to organise the farmers before anything can be done to place them in their true economic position. He explained in full what had been done in this direction in Queensland, and indicated that although voluntary co-operation had done a lot for the dairying industry in the manufacture of dairy products, it had not been an entire success in the more important matter of marketing; and farmers are now admitting that where more than one State is concerned, legislative backing and some form of compulsion are absolutely necessary. Such legislation, continued Mr. Gillies, could only become effective if the other States and the Commonwealth followed Queensland's legislative lead. As it is, Queensland has gone as far as possible with her own legislation, and constitutional difficulties have now arisen. In respect to finance, this State has been asked to undertake what is really the duty of the Commonwealth Bank. He considered this bank should finance the primary and secondary industries of Australia, and showed that, as a result of organisation, the commercial and manufacturing interests, although they have not one-half of the security in the aggregate which the primary producers possess, they are able to get the financial assistance they need on most favourable terms, while farmers, acting individually, do not enjoy the same facilities. Large sums are not required for the marketing of primary products, but complete organisation and control will largely solve the financial problem. The success achieved by the Wheat Pool and the Sugar Board he pointedly quoted, referring particularly to the saving of £50,000 in freight alone by the latter body through their being able to speak with one voice to the shipping companies. He also referred to what had been done in New Zealand by the Massey Government in the Acts for the marketing of butter and meat. Mr. Gillies quoted the Prime Minister's (Right Hon. S. M. Bruce) speech at the opening of the recent Sydney National Show, wherein he promised to "assist primary industries, but as a condition precedent to Federal Government assistance, every industry had to thoroughly organise itself, demonstrate that it was on an efficient basis, and satisfy the Government that permanent results would be achieved." If this promise means anything, it means that farmers must be properly organised, and set up their Marketing Boards before Mr. Bruce can carry out his promise with regard to oversea markets and freight subsidies. Mr. Gillies urged the other States to follow Queensland's example, and then demand the fulfilment of Mr. Bruce's promise.

Other Important Matters.

Other matters, such as a uniform standard of examination for testers and graders of milk and cream, the testing of purebred stock, the marking of pedigreed cows for identification, the inspection of Australian dairy produce in Great Britain, investigations into the manufacture of dairy produce overseas, breaches of the Dairy Agreement by Commonwealth officials, the control and eradication of tuberculosis in stock, the establishment of a veterinary hygiene branch, and the facilitating of stock traffic between States were considered by the conference. The restrictions on the movement of cattle from Queensland to New South Wales and Victoria, and of live pigs from Queensland to Victoria, were withdrawn and left for consultation between officers of the States directly concerned. Matters relating to the wheat industry, apiculture, poultry and eggs, and the interchange of crop reports were also dealt with, as well as items regarding pure seeds, entomology, agricultural chemistry, and the necessity for the installation of thermographs in cold chambers on ships. At the conclusion of the assembly, it was decided that the next Conference of Ministers of Agriculture be held in Hobart in May, 1925.

THE GEOGRAPHICAL DISTRIBUTION OF COTTON.

PRODUCTION, MANUFACTURE, CONSUMPTION.

BY G. EVANS, C.I.E., M.A. (Cantab.), Director of Cotton Culture, Queensland, and of the Empire Cotton Growing Corporation.

Paper read before the Royal Geographical Society of Queensland, 30th April, 1924.

The serious shortage of cotton that exists throughout the world at present renders the subject of this lecture of perhaps more than passing interest. Its importance will be realised by people in Australia in general and to residents of Queensland in particular because, as you all know, strenuous efforts are now being made to establish the cotton-growing industry on a permanent basis in the Commonwealth. Queensland especially seems to be a State well suited for the cultivation of this crop.

The British Empire consumes an enormous amount of raw cotton each year, the Lancashire mills alone requiring about 3,500,000 bales, and it is a remarkable fact that we do not produce more than a fraction of the cotton that we require for our consumption. The present shortage, which is mainly due to the reduced yields of the crop in the United States of America, has emphasised this point, and has brought home to everyone in the Empire the grave danger in which we stand at the present time. Not only are our great manufacturing industries languishing on account of the scarcity of raw cotton, which we can only buy at a great price and with difficulty after the great producing countries have satisfied their own wants, but cotton is one of the most important of all war materials.

It will be seen, therefore, that of the three headings into which my lecture has been divided, that of the actual production of the raw material is by far the most important at the present time, because, if raw cotton is not made available in sufficient quantities, the manufacturing industries must necessarily be seriously affected and the consumption will be correspondingly lessened.

In this lecture, therefore, I propose to devote most of the time to the questions concerning the production of the raw material, and shall then discuss the manufacturing and consuming areas.

I shall avoid statistics as far as possible, because I know that a mass of figures generally prove uninteresting and tiresome to an audience, but will endeavour to speak in general terms and will also try to stick to the geographical aspect. It is proposed to deal with the situation first from the world standpoint and then go into more detail so far as Australia and Queensland are concerned.

The Conditions Essential for Production.

Everybody realises that cotton will not grow anywhere. Even where the climate and soil are satisfactory for the growth of the plant, certain economic factors may exist which prevent the successful cultivation of the crop on a commercial scale. The incidence of diseases and pests are also very important, since, if they are prevalent, cotton production is naturally hampered.

Climate.

The cotton plant requires considerable warmth and moisture for its satisfactory growth, and it is therefore grown only in the tropics and subtropics. About six or seven months are occupied in the growing and complete maturing of the crop. In other words, there must be a period of from 180 to 210 days between the last spring frost and the first autumn frost, because the plant is damaged by a few degrees of frost. During the growing season a mean average temperature of 65 deg. to 80 deg. is desirable, and the temperature should further be fairly uniform since the plant is sensitive to sudden changes, and checks tend to produce premature ripening. During the first two months of growth fairly cool weather and a fairly light rainfall are desirable, as the plant then develops a good root system, becomes tough and hardy, and forms the fruiting habit. A somewhat heavier rainfall and warmer weather is desirable during the middle season when the plants are putting on fruit. During the last two or three months a lower temperature and drier conditions are necessary to check vegetative growth and enable the bolls to ripen. Fine, dry weather is also essential during the picking season to enable the crop to be picked clean, since in bad weather the fibre is apt to become stained.

The rainfall most suitable for cotton varies between 25 inches to 40 inches, varying with the latitude, class of soil, &c. In some countries, such as Egypt and the

Punjab, where the rainfall is deficient, the necessary moisture is supplied by irrigation. Generally speaking, the heavier the rainfall the lighter and better drained the soil and situation must be, because water-logging is fatal to the cotton plant. Probably the highest rainfall under which cotton is actually grown as a commercial crop is in the Garo and Chittagong Hill tracts on the borders of Assam, Burma, and China. Here the rainfall during the growing period is extremely high, averaging about 90 inches, and the type of cotton grown (*G. aboreum assamica*) is probably the shortest commercial cotton in the world, the staple being very rough, harsh, and coarse, and being chiefly used for upholstering, linoleums, or packing, and not for spinning. Attempts to introduce a better quality cotton have been made from time to time but have failed, and even this poor type of cotton can only exist in this rainfall for the simple reason that the seed is planted on the steepest hillsides and thus gets complete drainage at the root.

In most of the cotton-growing countries of the world cotton is grown on a variety of soils, but speaking as a general rule the most suitable soils are always those of fair depth, and consisting of good medium loams containing a fair amount of sand and silt, along with a good natural drainage and a fair capacity for retaining moisture.

Economic Factors.

The economic factors that are of importance are the incidence of population on the land, the state of development of railways, roads, ports, and proximity to markets.

It is necessary to realise that cotton requires more labour than many other crops. A good farmer may be able to plant quite a large area, but he will require to employ extra labour at two periods during the growth of the crop. The first of these is the thinning out and chipping stage. The seed is planted in rows, and when the young plants are about 8 inches high they must be thinned out and all weeds cleaned out from between the plants. If this operation is delayed, the plants assume a wrong habit of growth and the subsequent yield is greatly reduced. To some extent the necessity for employing labour at this stage may be obviated by mechanical means, but speaking generally, the method of thinning out by hand has, up to the present, been found to be the most suitable. The second period when labour is absolutely necessary is during the picking season. The cotton plant, unlike many other commercial crops, ripens unevenly, so that unripe bolls, ripe bolls, flowers, and squares are usually found on the plant all at the same time. This necessitates going through the crop three or four times for picking. In wheat and other cereal crops the whole ripens more or less evenly, so that it can all be harvested at the one time and in one operation. This, as I have pointed out, is not the case with cotton, and although a number of machines have been invented and claims have been put forward that the problem has been solved, it is noteworthy that none have yet been adopted on a commercial scale. These machines are designed either on the suction system or on the principle of a series of bristles which entangle the ripe fibre and carry it to the picking receptacle. Without going into details it may be mentioned that the chief obstacles operating against the success of these machines are, firstly, that the grade of cotton picked is low owing to the amount of trash and leaf that is picked with the cotton, and secondly, the amount of damage that is done to immature bolls and squares by the machine during its passage through the field. It is just possible, of course, that a successful picking machine will eventually be produced, and when this has been achieved, it will mean a revolution in the cotton-growing industry, since the scarcity of labour and the high cost of hand picking is undoubtedly prohibiting the rapid introduction of cotton cultivation into several parts of the world where the conditions are otherwise favourable. It would certainly have a very important effect in Australia for the abovementioned reason, since here agricultural labour is scarce on account of the sparse population, and agricultural wages run higher than in most countries on account of the higher standard of living. If successful mechanical cotton-pickers are eventually to be introduced, however, I think it will necessitate close co-operation between the mechanical engineer and the scientific plant-breeder. The latter's aim would be to breed a compact type of plant which would mature the whole of its crop of bolls, or, at any rate, the greater part of it, more or less at the one time.

Pests and Diseases.

The cotton plant, like other highly specialised cultivated crops, is very liable to insect pests and fungus diseases. The Mexican boll weevil (*Anthonemis grandis*),

for example, has seriously reduced the yields in the United States of America. The following statement shows this very clearly:—

Five Year Period.	Average Acreage,	Average Yield in Bales.	Average Yield per Acre. lbs.
1910-1914	35,900,000	14,259,221	192·1
1919-1923	35,200,000	10,531,415	146·9

In other words the average acreage during the five post-war years is only slightly less than that of the five years immediately preceding the Great War, and yet the crop has dropped by 3,750,000 bales because the yield per acre has become much less. This decrease may be ascribed mainly to the depredations of the weevil, either directly or indirectly, although other economic factors have had some influence. The greater part of America's cotton belt is now infected, and in an attempt to outrace the pest large areas are now being planted in Virginia and Southern Illinois, where the crop has hitherto been practically unknown.

Similarly, the pink boll worm *(Platyedra gossypiel'a)* has caused great damage in many countries such as Egypt, India, the African Colonies, Brazil, &c., so much so that practically every cotton-growing country where the pest is known to occur has had to bring in special legislation with a view to combating this pest. Other pests and certain fungus diseases also occur and do much damage, and it is for this reason that certain areas, more particularly those within the tropical zone and with a humid climate, have found it impossible to produce cotton as a paying commercial crop. On the other hand, countries further away from the Equator, possessing a colder winter season, sometimes find that pests can be more easily controlled. Clean cultivation is an absolute factor, and it is because this point is not clearly realised by the grower that cotton-growing is so hard to establish in some of the countries where this crop is new.

The Cotton-growing Countries.

According to the International Agricultural Institute for Rome, the average area under cotton from all the countries in the world furnishing data was about 58,500,000 acres in 1921, or slightly less by 1,000,000 acres than the ante-war period. The total yield of cotton was estimated at something under 21,000,000 bales. By far the largest producer is the United States of America, with an area varying from 33,000,000 to 38,000,000 acres and an output of 10,250,000 bales in 1923-1924, or 51 per cent. of the world's total output. India comes next with about 22,000,000 acres and 5,000,000 bales. The area under cotton in China is unknown, but it is probably very large, and she produces at least 2,000,000 bales. Egypt usually has about 1,500,000 acres, and she produces round about 1,000,000 bales. This is a high yield per acre and is a testimony to the fertility of her soil, the excellence of the irrigation system, and the skill and industry of the "Fellahin." Other countries, too numerous to mention, make up the remainder, but some of the more important of them will be mentioned later.

A glance at the map indicates that the areas under cotton cultivation are mainly subtropical, and not tropical as is so often supposed. In only a few instances do these areas extend beyond the 40 deg. parallel north (China, Korea, Turkestan), and only in South Africa and in New South Wales and on the Murray in Australia do they approach below the thirtieth degree in the Southern Hemisphere.

The subtropical areas produce practically the whole extent of the crops in the United States, Russia, Asia, and China, with portions of the Mexican, Indian, Persian, and Egyptian areas, as well as South Africa and Australia; also the limited areas along the Mediterranean, Cyprus, Malta, &c.

Within the tropics are found the West Indies, Peru, Brazil, Tanganyika, Uganda, Sudan, and the West African colonies; the peninsular of Queensland, Cambodia, and the West Indies, &c. It is worth of note that by far the greater part of the cotton is grown in the Northern Hemisphere, and that the great cotton-producing areas are those in which not only is the climate suitable, but also in which agricultural labour is plentiful and has, up to recent years, been comparatively cheap—India, China, and Egypt are instances. The United States of America has also achieved her prominence as the leading cotton-producing country in the world, owing partly to her abundant and efficient labour. Brazil is rapidly forging ahead as a great cotton country, and is solving her labour scarcity and filling up her vacant spaces by an influx of immigrants. Before the war these mostly came from Central and Southern Europe, but

during the last few years the tide of Japanese immigration has set in very strongly, and thousands are now entering each year from that country and engaging to a great extent in the cotton-growing industry.

The lands south of the equator are not nearly so closely populated or highly developed as those north of the line, but it seems likely that the present century will see this state of affairs changed and that they will produce a bigger proportion of the world's crop in the near future.

Let us now turn briefly to Russia's cotton-growing area in Turkestan. This area affords a sad illustration of the extent to which a large agricultural industry can be ruined by the calamity of war or a political revolution. Russian Turkestan, as has been mentioned before, is the furthest north of all the important cotton tracts. The country is practically rainless and is surrounded by desert, and is dependent largely on irrigation. The climate is very cold in the winter, but the summer, although comparatively short, is extremely hot. Early maturing varieties of cotton are successfully grown under these conditions, and the cold winter keeps down the yests, minor damage being only occasionally caused by flights of locusts. With the outbreak of the Russian Revolution the whole industry became upset, the growers left or were unable to cultivate, and the canals fell into disrepair, so that Russia, which in 1913-14 produced nearly a million bales, is only estimated to produce 180,000 bales in the coming season.

This potentially great area is bound to recuperate in time, however, and again take her place as on eof the big cotton-producers of the world.

Cotton-Growing Areas in Australia.

I have gone into some detail in discussing this somewhat remote area because it seems possible that the climatic conditions there are somewhat similar to those of certain parts of Australia, where thoughtful people are now considering the possibilities of introducing cotton-growing. The particular areas meant are in the dryer areas of this continent, along the Murray and Murrumbidgee Rivers. Here cotton, if it can be grown, will have to be irrigated. The winters are cold and the growing season is short, but the summer, like that of Turkestan, is hot owing to its proximity to the enormous arid interior of this continent. There would seem to be no reason why cotton should not grow and yield well in these areas provided an early maturing variety of the right type is cultivated. In this connection it is probable that a close investigation into the methods of cultivation employed and the types of cotton used in far-away Turkestan, where cotton-growing has already proved a pronounced commercial success, would be amply worth while. This is the only part of Australia where cotton is likely to be grown under irrigation just now, although it is possible that when the irrigation schemes that are now maturing in Queensland, west of the Main Range, begin to function, it may pay to grow cotton with the help of irrigation water.

Northern Territory and the Nor' West.—The main crop of this country will, however, be rain fed and not irrigated. Apart from Queensland, which is the main cotton-producing area, and which we shall again refer to presently, this crop has been successfully experimented with in parts of New South Wales and the Northern Territory, and is also being tried in the North-west of Western Australia. In these two latter areas it is noteworthy that the summer temperatures are high and that the rainfall mainly falls during the growing period of the crop. An interesting illustration of this necessary correlation of rainfall and temperature is shown by a reference to the rainfall statistics of Western Australia. In the southern portion, as far up the coast as Geraldton, the rainfall falls almost entirely during the winter months, with the result that the main crops are the cereals of the temperate zone—viz., wheat, oats, &c. In the middle belt, although the summer is hot, the total rainfall is very light and is not sufficient for the cultivation of any crop except under irrigation, which is not at present available. The whole of this vast area is therefore pastoral, and is one of the most important wool-raising tracts in the world. In the neighbourhood of Broome, however, monsoonal influences begin to appear, and from thence northwords the country has a summer rainfall which is said to be as much as 70 inches in the neighbourhood of King George IV. Sound. At Derby, the rainfall is over 30 inches, but the amount of land available for cotton does not at present seem to be very large, although the Western Australian Department of Agriculture may eventually discover a suitable area within reasonable distance of a port. It must be remembered that the greater part of this country has never been properly surveyed from an agricultural point of view. The highlands consist of light sandy red soils, which have no subsoil and are consequently liable to dry out very quickly and to become extremely hot on the surface. The alluvial flats along the river valleys are, on the other hand, subject to inundation and are therefore unsuitable for cotton. There are indications, however, that in the

valley of the Drysdale River and in the country between Wyndham and Hall's Creek the climate and rainfall are both suited, and that large areas of suitable soil also occur. The prohibiting factors at present are the lack of population and the lack of communication and facilities for getting the crop down to port, and so to the markets. Similarly, in the Northern Territory the rainfall is monsoonal, falling entirely in the summer months. There is remarkably little land within 200 miles of the coast that is suitable for cotton. The land between the valleys consists of thin soils overlying clay pan, and the chief features are pandanus palm, which usually indicates a water-logged soil, and the enormous anthills, which are generally taken as showing that the soil is hungry. The alluvial flats along the big rivers, such as the Daly and the Adelaide, are extensive in the lower reaches, but are liable to flooding and, from what little I was able to see of them, would be best suited to the cultivation of wet rice or jute. Both these crops require a dense population to be successfully dealt with, and, as we all know, this is not forthcoming at present. I am not a sufficiently good geologist to hazard a statement, but it seems just possible that the whole of the north coast of the continent is gradually sinking. If this is so, it would account for the reason why all the alluvial flats and river valleys are so liable to inundation. In the upper reaches of these rivers, along the coastal belt of the Northern Territory, the alluvial lands are narrow and somewhat infrequent, and the rainfall is likely to prove somewhat too heavy and continuous for cotton. I did not, in fact, come across any really large body of land suitable for cotton cultivation until I got to the Roper River, some 300 miles south of the coast, although a few patches of fair land occur along the Katharine River and some of the creeks. In the Upper Roper Valley, however, it should be possible to grow excellent cotton, given the necessary agricultural population and facilities for marketing and handling the crop. The land consists of large areas of sandy to medium alluvial loams situated above flood level, and the rainfall is not too heavy, but is regular and consistent, averaging about 32 inches, all of which fall in the growing period. The picking season has fine weather, and it should be possible to keep the pests in check by means of burning the old stubble and rubbish at the end of the dry season. The new extension of the railway from Katharine to the Daly Waters will open up this country and solve the difficulty of handling the crop. The progress of cotton-growing in these areas will, however, depend entirely on the success that attends any scheme for settling an agricultural population on the land. The aboriginal population is fairly thick, and I personally think that, if treated properly, they can be relied on to give a good deal of casual labour in the initial stages. The few settlers who are attempting to cultivate the land at present in these parts are employing the aboriginals for clearing the land, weeding and thinning the crop, and also for picking. Although not, of course, adepts, the work I saw them doing was quite satisfactory, considering that most of them have never been engaged in agricultural operations before. Many of these people are of fine physique, and are certainly not devoid of intelligence, and for casual labour, such as is required during the picking season and for thinning, I have no doubt they will prove of great assistance to the pioneer farmer in these parts. Whether any large influx of settlers will be attracted to these parts I cannot say, but I should imagine that the less remote parts of Australia will be occupied first.

New South Wales.—Turning now to New South Wales, we find that considerable attention is being paid to cotton in the valleys flowing east from the Main Range to as far south as Sydney. Both rainfall and summer temperatures are suitable for the growth of cotton in these parts. On the coast itself and at the mouths of the rivers flowing into the sea it is possible that the rainfall may prove too heavy and the atmosphere too humid in the autumn during the picking season. Fifteen or twenty miles inland, however, these conditions disappear, and the result is that cotton of the finest quality has been grown on the middle and upper reaches of the Richmond, Clarence, and Hunter Rivers. On the upper reaches, when the rainfall averages 26 inches to 32 inches, the most suitable soils would appear to be the sandy alluvial flats, which cover large areas along these valleys.

On the west side of the Main Range experiments are being carried out, and it seems probable that this valuable money crop may be introduced in parts of the north-western and central-western slopes, where the necessary summer rainfall occurs. Both these areas have a somewhat short season, however, and it is possible that early ripening varieties will give the best results.

Queensland.—Turning now to Queensland, we find that the temperature is everywhere suitable for the commercial cultivation of the crop except on the higher elevations at the top of the Main Range, in such localities as Stanthorpe, which is probably too cold. In Queensland the rainfall is the limiting factor. The rainfall map of the State indicates that the incidence of rain over an average of years is curiously uneven. We have wet belts, such as the Tweed, Nambour, Bundaberg, Proserpine, and Mackay, and further north at Innisfail and the Cairns country, in which the rainfall is probably too heavy over a series of years to suit cotton. In

one or two of these areas, where the rainfall is not much more than 40 inches, it is possible that cotton may grow well on the lighter soils and in well-drained situations. Generally speaking, however, the plant is inclined to put on too much wood in these tracts, and attacks of diseases and pests are more prevalent. Some of these diseases are indirectly encouraged by the humid atmosphere. Thus an internal boll-rot disease, which is prevalent on the coast, is caused by certain sucking bugs and grubs, which puncture the boll and incidentally let in the spores of a certain fungus which could not otherwise gain entrance. This fungus then sets up a rot and destroys the young cotton, and is causing damage chiefly in the coastal belt.

Speaking generally, therefore, we find that the conditions which are most favourable to the production of a commercially paying crop exist in a belt of varying width between the New South Wales border and Mackay. The average rainfall in this belt varies from 25 to 40 inches or so, and the area of land comprised in this cotton belt amounts to many millions of acres.

It is necessary to point out that the whole is not culturable, however, as the area I have indicated is extraordinarily broken up into narrow valleys and plateaux, with large areas of rocky ranges and ridges covered with indifferent and shallow soils which are only useful for light grazing. Nevertheless, the total area of good cotton land that is available for development is very large, and when we remember that other large areas occur north of Mackay, which have not yet received much attention from a cotton point of view, I think you will agree that we have in Queensland one of the few large untapped potential cotton-growing areas remaining in the world.

The soils in this area are extraordinarily mixed; in fact, to a person accustomed to large cotton-growing countries in other parts of the world, this fact is very forcibly driven home. In India, we find thousands of square miles of black cotton soil in the Deccan and Berar, and the same occurs in Texas, whilst in Egypt and Mesopotamia one is dealing all the time with an alluvial soil. In the Queensland cotton belt, with rare exceptions, this is not the case. You may be standing on a deep black clay valley bottom which merges on the slopes into a chocolate loam covered with silver-leaf ironbark trees. Within rifle shot in one direction you may see cotton growing on a light red powdery volcanic soil of great depth and famous for its prolific maize and fodder crops, whilst at an equal distance in another direction one may drop down into a shallow valley and admire some extensive alluvial flats of splendid sandy loam in which the typical tree is the Moreton Bay ash, a sure sign, as a rule, of a first-class cotton soil. Again, a few miles further on, the eternal gums of the Australian forest may give place to a different flora, and we may find ourselves in a thick scrub of deciduous bushes and trees, prominent among which is the well-known bottle tree. This, however, is not a treatise on ecology, and enough has been said to indicate the extraordinary variety of the soils and the intricate way in which they occur. Experience is beginning to teach us that all these soils are not equally suited to cotton, and that year in and year out certain types are more satisfactory than others. Farmers in the South-east and the Maranoa now realise to a great extent that the medium and sandy loams are the most suited, one of the reasons being that, if properly cultivated, they retain moisture well, and an early plant, which is essential for the greatest success, can then be obtained. The heavy black soil may give good results in certain years, but is more difficult to work up into a seed bed and is hard to keep free of weeds during the rainy period.

The boom period of cotton is now passing and we are all getting down to hard facts, and one of these is that cotton, if a good paying crop is to be obtained, must be farmed properly, just as any other crop is; slipshod cultivation is fatal. It is also beginning to be realised that it has its own requirements regarding class of soil, methods of cultivation, &c. It will have its ups and downs such as any other crop will have in a climate such as Queensland's, where the rainfall is not entirely dependable, but it is now believed that cotton, if properly farmed, is more likely to give a crop during a semi-drought period than any other commercial crop. It also has the further advantage that its price is not dependent on the local market, and is not, therefore, subject to sudden and distressing drops owing to over-production. Cotton is a world commodity, and we all believe that the shortage of raw cotton is such that the price is not likely to drop for a good long time.

With regard to pests we have our troubles since they have proved destructive in some parts this year. Pests, however, are generally bad after a drought, and cotton, it must be remembered, was not the only crop attacked. Other countries have, however, the same pests that we have, and by the adoption of sound precautionary and remedial measures (of which the most important are clean farming and a "dead" season) have continued to keep them in check. It is difficult to believe that the Queensland farmer cannot do the same. Finally, we must remember that we have not got the boll weevil, which, perhaps, is the most destructive of all cotton pests and the most difficult to combat.

Having discussed briefly these factors in the successful production of cotton in this State, we now turn to one of the most important factors of all—namely, that of population. Owing to the scarcity of population it is unlikely that cotton will be grown in Queensland to any extent on the plantation system. The tendency is for a farmer to put in a few acres of cotton along with his other crops. In other words, he goes in for mixed farming, thereby planting and cultivating as much cotton as he, with the help of his family and a few friends, can pick. By so doing he nets a return which helps to materially swell his credit balance at the end of the year. The tendency is all in this direction this year, and is shown by the fact that we have about 60,000 acres under the crop grown by about 8,000 or 9,000 farmers. This area, in a normal season, would be expected to yield about 20,000 bales, with, let us say, at the current prices, a value of about £700,000. Let us presume that there are an equal number of farmers who farm land in the cotton belt who are not yet growing cotton. Should they take up cotton-growing we might possibly get double this output, or if the season were exceptional even 50,000 bales. That would be somewhat about our limit at present, and we cannot hope to get much more unless land is taken up for cultivation inside the cotton belt much more quickly than is happening at present.

When we realise that the world's shortage of cotton is about 3,000,000 bales, it will be seen that Queensland's possible contribution towards meeting the deficiency is a somewhat modest one at present, although the potentialities undoubtedly exist.

MANUFACTURE AND CONSUMPTION.

Cotton a Comparatively Recent Commercial Product.

It is not generally known that cotton has sprung into importance comparatively recently, and it is difficult to realise that a little more than 200 years ago cotton was practically unknown to civilised western nations. It was, of course, known before that in the East, but was not so important as other fibres, and the Sanskrit word "Karpasia" originally meant flax and not cotton. Herodotus, in 450 B.C., refers to a cotton material, but this is probably the kapok (*Bombax malabaricum*), the silk cotton tree which is so common in the East Indies. By the beginning of the Christian Era, however, Indian cotton is first mentioned in the commercial circles, and the painted calicos of Masalipatam and the famous muslins of Dacca were beginning to be well known.

It is only in the last century and a-half, however, that cotton has come into its own. In 1784 the British Government seized eight bags of cotton imported from the United States of America, on the ground that no such large quantity of cotton could have been produced in that country. To-day it is estimated that the world's total consumption of cotton would, if the purchasing powers of the people were normal, be in excess of 22,000,000 bales of 500 lb. net (lint).

The Reason for its Rise in Importance.

The first cause of this tremendous increase was the introduction of textile machinery. The spinning jenny was invented by Hargreaves, in Lancashire, in 1764, and since then continual improvements have been made until the modern textile machinery has been evolved. The introduction of machinery enabled fibres to be made up into fabrics at a greatly reduced cost, and therefore a greater demand arose, necessitating the use of a cheap fibre. The advantages hitherto enjoyed by cotton have been a relative abundance of supplies and a low price as compared with other fabrics of a similar nature, such as silk, flax, and even hemp and jute. The two former in particular were not only more exacting in their requirements, but were more expensive to produce.

About fifty years ago cotton was chiefly used for wearing apparel, and apart from sail cloths, tents, &c., the demands for it from other branches of industry were negligible. Production was, therefore, limited to the purchasing power of people for clothes.

Within the last forty years, however, the use of cotton has extended far beyond that of producing clothes for the peoples of the world. The price depression in the "nineties" caused cotton to become so abundant and cheap that it began to be used as a substitute to replace other products. Trials in this direction indicated that cotton was not only cheaper but was often more satisfactory than the original product, and further experiments resulted in still further uses being made of it, so that in many industries it has now become an essential for which no substitute can at present be found.

New Uses for Cotton.

A few examples of these new uses may prove interesting. With the rising price of leather it was found that heavy duck or rubber with a basis of cotton proved an efficient substitute for belting, and thousands of bales of cotton were required annually for this purpose. In the same way cotton bags have largely displaced wooden barrels in transporting substances such as cement, lime, &c.

Another very large consumer is represented by the railways of the world. Thousands of bales are consumed annually in the manufacture of air-brake hose, of fabrics for the seats and cushions, whether plush or artificial leather, and for enamelled ceilings, which are usually cotton cloth covered with a coating of enamel.

An industry of quite recent development is the automobile business, and this has now become the greatest single consumer of cotton and cotton goods in the United States. That country has an annual output of 2,000,000 cars or so, and it is obvious that the amount of cotton required for tyres, hoods, seats, and cushions must be enormous. One tyre manufacturing company alone is reported to use 120,000 bales or thereabouts each year, and it is evident that the time will not be far distant when 500,000 bales at least will be required for the automobile industry. Finally, there is the use of cotton as a war material. Nowadays cotton comes next in military importance to chemicals, copper, and petroleum. It provides not only clothing for the soldiers, but tents for their shelter, tarpaulins for stores, and sand bags for the trenches. It is also one of the most important essentials entering into the manufacture of high explosives. Warships use an enormous quantity of cotton for awnings, &c., and it is, of course, largely used in the construction of aircraft.

The Present Shortage.

In other words, the utilisation of cotton in so many new industries has caused a greatly increased demand within recent years which the producers of raw cotton have barely been able to meet. Following on the serious position as regards supply which was evident before the war, that great calamity resulted in an enormously increased consumption, with the result that the reserve stocks rapidly disappeared and do not now exist. There is, therefore, a great rise in prices, and extraordinary endeavours are being made in many parts of the world to grow more cotton. The present shortage is somewhere about 3,000,000 bales, and it will probably take many years of strenuous endeavour to make the supply approximate again to the demand. There seems to be no prospect of any material drop in the prices for some time to come in the existing circumstances.

The Consuming Countries.

In the old days cotton was mostly grown in the East, and was there made up into cloth on hand looms. In those times piece goods were actually imported into Europe by the Western nations. With the invention of textile machinery towards the end of the eighteenth century, however, industrial centres arose in Lancashire and other parts of Europe, and a rapid change in trade relations resulted. The better educated and more industrially efficient Western nations found that they could afford to import raw cotton from the growing countries, and by reason of the cheap methods of textile machinery make it up into cloth and export and sell it at a profit overseas.

The rapid rise of the United States as a cotton-growing country, coupled with the introduction of steam power into ocean-going vessels, enabled the cotton so produced to be transported cheaply and rapidly to the mills in the industrial centres of Europe, and this gave rise to the great textile industries that we know of to-day in Lancashire and other centres. The American Civil War caused a serious depression in the Lancashire cotton industry, and it is interesting to note that even in 1863, as a result of the shortage of raw cotton directly resulting from that war, there was an outcry against the continuance of dependence of the United States of America for supplies of raw cotton. With the establishment of normal conditions in the Southern States and the rapid settlement of further cotton-growing areas, however, the supplies again became large, and the Franco-German War of 1870, which seriously upset the textile industry on the Continent, further strengthened the English manufacturers.

Even at this stage, however, the tendency had arisen for the cotton-growing countries to start manufacturing their own cotton goods, and this tendency has increased rapidly within recent years, so that not only the United States of America, but other cotton-producing countries, such as India, China, Brazil, and Egypt, are now making up large quantities of their raw product. The following figures are instructive and illustrate this point:—

Estimated Number of Spindles (000's Omitted).

—	1880.	1900.	1920.
Great Britain ..	41,000	42,460	58,692
United States of America ..	10,700	28,349	35,834
Continent of Europe ..	21,500	40,577	43,264
India ..	1,700	5,657	6,689
Japan ..	..	3,690	3,690
China ..	..	..	1,600

This table shows clearly that the United States of America, India, and China are all now manufacturing their cotton and that less therefore is available for the manufacturing, but non-cotton-producing countries, such as the European countries and Japan.

The United States of America mills were, until comparatively recently, mostly located in the northern States outside the cotton belt, but there has been a tendency of late to erect mills on the spot where the cotton is produced. Probably the idea is that in lean years these mills will be in a better position to secure supplies of cotton. Possibly, also, labour conditions may be easier. In any case it is a remarkable fact that whereas in 1860 Southern State mills only consumed 178,000 bales; in 1921 they purchased nearly 3,000,000 bales.

The proximity to supplies is not, however, the only factor that tends to favour the establishment of cotton manufacturing mills. The nearness and extent of the markets has also to be taken into consideration, and the standard of technical skill and the capability of hard, honest, and intelligent work that the inhabitants are capable of producing have to be borne in mind. In the latter respect the European countries had for many years a comparative monopoly, and were at a great advantage compared with the Oriental nations which were more behindhand in this respect. The recent rise of Japan can be instanced, however, as an example of the way in which a nation can rise successfully over obstacles of this sort. This country buys most of her cotton from India, but more recently has also been purchasing better quality fibre from America and other countries. She has made herself to learn the intricacies of the textile trade, and has a large and ready market at her door, not only at home with her large population, but in China and the other countries of the East with their teaming millions. India also has her market within herself, and not only produces the cotton, but has natural resources in the shape of coal and cheap labour. Her industrial education has been less rapid, however, and her progress has not therefore been so phenomenal as Japan.

The United States of America appears to be the best situated of all nations for cotton manufactures. She has a large internal consumption which requires cotton, not only for clothing fabrics, but also for many other highly organised industries, and she has an intelligent and skilled industrial population, great material resources in the shape of oil, coal, and water, and, in addition, produces the bulk of the world's cotton. Many people believe that in a few years' time the United States will consume all the cotton she produces, and that there will be little left for export. Compared with the States, Europe seems to be badly situated in that she produces practically no cotton and has to import all of it from overseas, often from a considerable distance. It must be remembered, however, that she has a large market right at her doors, and a market that in normal times can pay well and requires the finest materials. Further, her cotton manufacturing industries are highly specialised, and the workers have an apparently hereditary skill in their work. The machinery used is up to date, coal is abundant, climatic conditions are particularly favourable, and the markets are well organised and established. The tendency for Lancashire in particular is to concentrate on the manufacture of high-class goods, which some of the other countries new to the industry cannot at present emulate.

One of these days it is possible that Australia will manufacture cotton goods, but the most important work she has before her just now is to produce more cotton. Queensland's cotton output last season was 7,736 bales only. A modern spinning mill will consume somewhere about 40,000 bales in a year, and owing to our distance from other cotton-growing centres, it is doubtful whether it would pay to import in large quantities. Moreover, our population is small, and the internal market is therefore necessarily limited, and since the costs of producing manufactured articles in this country are high, it is doubtful whether it would pay to export at present rates.

With an increased population and more people growing cotton, however, it would seem that some time in the future Australia will naturally take to manufacturing her own cotton goods.

SHEEP AND SOIL.

By J. C. BRÜNNICH, Agricultural Chemist.

The question has been raised—"What influence has the geology of a district on sheep breeding and wool production?" Geology unquestionably has an important connection with the soil, its composition and its fertility, as the soil is generally formed from the rocks found underneath and in the neighbourhood. Our practical sheepmen know from experience that limestone country is desirable for breeding of stud sheep; on soils of granitic origin, containing always a high percentage of potash, a particularly high-grade wool is produced; and that other districts with soil richer in humus and other mineral salts, and renowned for their excellent pasture, are particularly suitable for fattening.

Granting the influence of geology as a factor in sheep raising, it is very questionable if the recommended exhaustive geological survey of the whole State, which would involve an enormous expense and take some considerable time, would be of particular advantage to our pastoralists. Most of our large holdings have been chosen without any consideration of the geological aspect, and the fact remains that Queensland holds the proud position amongst all the Australian States to produce the highest class of wool. Even now, if one of our successful graziers should wish to take up a new lease, he would consider the soil, grass and herbage, climate and rainfall, accessibility, &c., without a study of a geological map.

A geological map may be frequently misleading when used to judge the soil, as the rocks below the surface are not always a true indication of the quality of the soil. For example, a soil may be very deficient in lime, although actually overlaying good limestone deposits. Only deeper-rooted trees and shrubs give a good indication of the geological strata, but not the shallow-rooted grasses.

The actual amounts of mineral plant foods removed from the soil by sheep are exceedingly small on our lightly stocked country, as will be seen from figures given below.

According to Lawes and Gilbert, of the Rothamsted Experiment Station, the following table gives the composition of the entire bodies (fatted weight) of sheep:—

—	Water.	Fat.	Nitrogenous Matter.	Ash.	Stomach and Intestines Content.
	Per cent. in entire body.				
Fat lamb	47·8	28·5	12·3	2·94	8·54
Store sheep	57·3	18·7	14·8	3·16	6·00
Half-fat sheep	50·2	23·5	14·0	3·17	9·05
Fat sheep	43·4	35·6	12·2	2·81	6·02
Extra fat sheep	35·2	45·8	10·9	2·90	5·18

The ash (2.9 per cent.) of a sheep contains—

Potash, K_2O.	Soda, Na_2O.	Lime, CaO.	Magnesia, MgO.	Phosphoric Acid, P_2O_5.	Silica. SiO_2.
Per cent. ·14	Per cent. ·13	Per cent. 1·19	Per cent. ·04	Per cent. 1·13	Per cent. ·02

Of 100 lb. of food consumed by a sheep, only 4 lb. are utilised to maintain life weight and to grow wool, and 96 lb. are voided as manure and lost by perspiration, &c.

It will be noted that the greatest variation in the composition is shown in the percentage of water and fat, whereas the nitrogenous matters and the ash show but slight change. The amounts of mineral matters are extremely small and consist chiefly of lime phosphate, but, although small, these constituents are of utmost importance, as they form the foundation of the whole structure and play important parts in the metabolic processes, and want or shortage of any of these mineral constituents in the food will quickly affect the health of the animal and its future development.

In order to form some idea what the sheep really take from the ground, we will assume an area of 100 acres on which 100 merino sheep, of an average life weight of 100 lb. each, are pastured, and giving an annual wool clip of 800 lb.

As a matter of fact, only the constituents contained in the wool clip are removed from the soil, and, of course, such constituents contained in the sheep which are sold, but for the present calculation we combine the constituents contained in carcass and wool. We find—

——	Nitrogen.	Potash.	Phosphoric Acid.	Lime.
	Lb.	Lb.	Lb.	Lb.
100 sheep at 100 lb. contains	237	17·4	119	132
800 lb. of wool contains	43	45	0·7	1·5
Total in sheep and wool	280	62·4	119·7	133·5
or per acre	2·8	0·6	1·2	1·3
One sheep will supply daily 2·3 lb. fæces and 1·1 lb. urine containing annually per acre	4 to 12	4 to 13	2 to 4	7 to 16

An average rainfall of 28 inches will supply per acre 3.7 lb. of nitrogen.

A soil (Maranoa district) contains per acre to a depth of 12 inches—

——	Nitrogen.	Potash.	Phosphoric Acid.	Lime.
	Lb.	Lb.	Lb.	Lb
Total	2,511	20,373	4,536	50,310
Readily available		474	226	

By taking this typical grazing soil from the Maranoa district, we find that according to the analysis we have a supply of mineral constituents which will last for thousands of years when used for grazing sheep at the rate of one sheep per acre.

A careful study of the above figures will show that the amount of nitrogen in the soil will easily hold its own; that the rainfall alone will supply more than the sheep can remove, and, in addition, there will be a considerabe accumulation of nitrogen by the growth of leguminous herbs, shrubs, and trees.

Wool removes a considerable amount of potash, but the biggest drain on the soil is made on phosphoric acid and lime. The sheep itself returns to the soil a very large amount of plant foods in the form of liquid and solid manure, and over 90 per cent. of all these plant foods taken originally by the grass and herbs from the soil are returned in the manure in a more readily available form for future crops.

Periods of drought, occurring from time to time in Australia, are nature's "fallow," and will lead to a continual accumulation of readily available plant foods, which account for the phenomenal growth of grass and herbage after the first good fall of rain.

Mature grasses and herbs contain comparatively less nutrient matters than the first young growth, more particularly with regard to mineral and nitrogenous matters, and this accounts for sheep doing so much better on young, short grass. When the growth of grass is very luxuriant, sheep may get their required amount of food in much shorter time, but it may be deficient in mineral matters, and lambs especially would suffer by getting an over-rich milk, deficient in mineral matters.

The amount of phosphoric acid in our soils is generally low, and it is therefore quite possible that in the surface soil the phosphoric acid may become depleted, and therefore yielding grasses deficient in this important constituent.

The instinct possessed by all animals drives them to lick soil, chew bones, &c., to satisfy a craving for mineral matters, and for this reason licks have been found beneficial all over the world.

The best and most natural method of supplying phosphoric acid and lime is by top dressing of the pasture with phosphatic manures and dressings, in accordance

with the composition of the soil, with either of the following fertilisers:—Bonemeal, Thomas phosphate, Nauru phosphate, Nauru phosphate and superphosphate mixed, partially dissolved Nauru phosphate, and meatworks fertiliser can be applied. Such manuring becomes an absolute necessity in heavily stocked countries, and is largely practised in many places with great success. Unfortunately, an extensive use of phosphates as a top-dressing of our pastures is out of the question, but every sheep-owner could have a small paddock top-dressed and used as a nursery paddock for ailing sheep. Anyone who has seen top-dressed pasture and the way in which stock rush the manured grasses in preference to natural unmanured grasses will become convinced of the value of top-dressing.

In many districts, however, a supply of licks containing lime phosphate has made unthrifty pasture valuable and able to produce normal healthy stock.

Salt has been used as a lick for stock generally since time immemorial, because salt in small amounts acts as a tonic and helps in the digestion of food and keeps sheep, more particularly, in a healthy condition.

Phosphoric acid and lime can be supplied in the form of sterilised bonemeal, and can be mixed in equal portions with the coarse salt. An excellent and much cheaper substitute for bonemeal is found in finely crushed Nauru or Ocean Island phosphate, which contains about 38 per cent. of phosphoric acid and 60 per cent. of lime, and is just as soluble as bonemeal in weak organic acids.

Addition of other medicaments in very small amounts, like sulphate of iron, iron carbonate, gentian, ferrugreek, &c., may give in some cases beneficial results.

The erroneous opinion has been expressed by a few that prevalency of the stomach worm (*Strongylus contortus*) has something to do with the soil, and that the composition of the soil is the cause of "wormy districts."

In conclusion, the following well-known facts may be here emphasised:—

(1) No country is naturally wormy, but any district may become worm-infested by allowing any ruminant, having stomach worms, to graze on clean country.

(2) It is absolutely futile to expect to cure sheep of stomach worms by giving them licks, or supplying lime in form of limy drinking water.

(3) Licks can only improve the health of sheep and supply any deficiency of mineral constituents lacking in the natural food supply. Healthy sheep will be able to withstand attacks of stomach worms and blowflies better than weakly or sick sheep.

(4) In order to build up normal healthy constitutions, lambs must be supplied with foods containing a sufficient amount of lime phosphate, and if deficiency of these constituents is suspected in the pasture, should get access to licks made of a mixture of lime phosphate and salt.

CANE PEST COMBAT AND CONTROL.

Mr. Edmund Jarvis, Entomologist to the Bureau of Sugar Experiment Stations, reports to the Director (Mr. H. T. Easterby) under date 28th April:—

Breeding Digger-wasp Parasites.

The work of breeding additional specimens of our scoliid wasps of the genus Campsomeris for introduction into Java has been continued during the present month, capture of these useful parasites and subsequent rearing of same in our laboratory from the egg to cocoon condition having been entrusted to Assistant H. Knust.

Digger-wasps were scarce in canefields throughout February, which was a dry month, but following on a fall of 5.62 inches of rain (from 3rd to 9th March) they emerged freely, and on the 10th of that month twenty-two female wasps were captured without any difficulty in about an hour. These were induced to oviposit regularly each day, so that early in April we were able to send a consignment of cocoons and larvæ to Professor Leefmans at Buitenzorg.

The present season happens to be particularly favourable for this class of control work, as grubs of *Lepidiota frenchi*, which are now in the third instar and form one

of the favourite hosts of *Campsomeris*, are available this year for such purpose during January and February, while those of *albohirtum* are procurable as usual later on in March to May.

Various original methods of packing these parasites were tried, with the object of reducing risk of injury during transit to a minimum. The consignment forwarded to Java this month consisted of sixty-five specimens, including intro-cocoon, larval, pre-pupal and pupal stages of digger-wasps of the genus *Campsomeris*.

Notes on the Economic Value of Parasites.

Our growers have long believed that the introduction into Queensland of some parasitic enemy of the grey-back cockchafer would afford a ready means of solving the cane-grub problem.

It should be remembered, however, that past experience has shown that this attractive phase of natural control has succeeded best when employed against insect pests which have accidentally obtained entrance into various countries, in which, being unchecked by their usual parasitic and other enemies, they have naturally been able to increase and multiply abnormally. It stands to reason, therefore, that control of such destructive species could most likely be effected in many cases merely by the introduction of those insect enemies which, in their own country, have always limited their activities.

The utilisation of parasites in this way dates back to about 1842, although perhaps the first notable success in recent times was achieved in 1889 by the introduction from Australia into California of a small lady-bird beetle (*Novius cardinalis*) to control our so-called "Cottony Cushion Scale" (*Icerya purchasi* Mask.), which, having found its way into the latter country, was working terrible havoc in the citrus orchards, defying all attempts at artificial control.

Nearly 11,000 specimens of these useful little beetles were reported as having been bred from specimens first obtained from Australia by the Department of Agriculture, and ultimately liberated in more than 200 affected orchards in California, where they cleaned up the citrus trees so effectively that in less than twelve months this formidable scale-insect was held in complete subjection.

Similar useful work was performed also by this lady-bird beetle in New Zealand, and later in Portugal, where the "Cottony Cushion Scale" had found an entrance and was fast ruining the orange groves.

Taking an instance of our own work in this connection, it may be mentioned that the well-known tachinid fly parasite, which is a natural enemy of the weevil-borer of sugar-cane in New Guinea, is at present being bred in considerable numbers by our Bureau of Sugar Experiment Stations and liberated amongst borer-affected cane in various North Queensland sugar-growing districts. Results derived from such liberations bid fair to prove highly satisfactory, this parasite of the borer having already been successfully established in many centres (see this report under separate heading below).

With regard to the possibilities of useful control work being achieved by parasites introduced into Queensland in expectation of their attacking grubs of indigenous species of cane-beetles, any success in this direction would necessarily depend mainly on the degree of relationship between the two species concerned, and incidentally on other natural factors too numerous to touch on in a monthly report.

Briefly, we know that many leaf-eating insects, when removed from their natural habitat, are nevertheless able to acquire new habits, and that a species, in order to persist and multiply, will strive to adapt itself to an unfamiliar dietary. Similarly, parasitic-insects, when unable to find their accustomed host, would for the same reason be compelled to accept the most fitting substitute that chanced to offer.

Such adaptability is, indeed, by no means rare among highly organised hymenopterous insects like digger-wasps, ichneumons, &c.

Tenacity of Life in Cane Grubs.

Laboratory experiments were carried out this month in order to determine how long a third-stage grub of *albohirtum* (grey-back) could remain alive under water during such conditions as might arise when low-lying river flats become completely submerged at flood time.

Full-sized grubs were placed singly in test tubes containing rain water, in which, after struggling a few seconds, they sank to the bottom.

About an hour later all motion had ceased, and they lay in doubled-up position with legs widely extended.

Grubs taken out of the water after intervals of 5½, 26, and 32 hours' submergence, ultimately recovered, while those subjected to 40 hours' immersion did not revive.

In a second experiment, grubs were found to survive a submergence of 41 hours; but others, although regaining slight movement, after 47 hours in the water did not live more than three days.

Again, others subjected to 66 hours continued motionless for a time and then commenced to decompose.

When first taken from the water all grubs felt cold and stiff, the body, however, regaining its usual flaccidity after an hour or so in moist soil.

Breeding Tachinid Parasites of Borer.

This branch of activity is being continued from month to month, and parasites are emerging at present in our rearing-cages in fair numbers. Latterly, most of these specimens have been females, some of which were liberated this month at South Johnstone, while others are being retained for breeding purposes. During the cooler months liberation will mostly take the form of breeding-boxes containing sticks harbouring pupæ of this tachinid fly, from which parasites will emerge and breed naturally among borer-infested cane left by the grower for this purpose.

It is interesting to note that on a selection at Merriwinni, where these flies were released about three years ago, they are now thoroughly established; and upon visiting the place in July, 1923, and again this month (March, 1924) plenty of fly-pupæ were discovered on each occasion in standing cane affected by weevil-borer.

Once established in this way the parasite will continue to do its part, unless unthinkingly destroyed or severely checked by firing of the trash throughout the area in which it is breeding.

Cane-grub Infestation.

It is early yet to state definitely the percentage of grub-attack likely to be experienced in the Cairns district.

Up to the present the weather has favoured growth of the cane, and the formation of fresh roots to replace those bitten through on grubby areas. During February and March there have been eight intervals—varying from one to eight days—on which rain has not fallen, the precipitation for these two months having totalled 26.70 inches. In spite of such welcome conditions, however, indications of the presence of grubs are to be seen at present (15th April) on high volcanic cane lands, being very noticeable over areas on which the cane was cut after flighting of the beetles.

In some cases ratoons on such land are little more than 3 feet high, and being already quite brown and drying up are practically worthless. Evidence of the presence of grubs may be seen, too, on the Greenhill Estate.

Grubs of *albohirtum* are now in the third stage and growing rapidly. During the next three weeks (terminating about 12th May) they will continue feeding voraciously on the roots and underground basal portions of cane-sticks.

Evidence obtained last season showed that these grubs do not, as some growers suppose, travel through a canefield, or even between the rows from one line of stools to another, but are content to remain among the roots of the stool under which the eggs they were hatched from were originally deposited by the parent beetle.

After devouring the main succulent roots the third-stage grubs usually commence eating holes in the underground portion of canes, and if present in numbers the whole stick is soon bitten through or so weakened that it is blown over and falls to the ground.

By the time the grubs have finished eating the basal portion remaining in the soil, the old "set" and the remains of any cane butts of a previous crop, it is about time for them to think of pupating.

When fallen stools are hidden or covered partially by trash, canes chancing to rest directly on the surface-soil are often eaten into by grubs which have come to the top of the ground under cover of the semi-darkness. It is not unusual to find cane sticks attacked in this manner, and nearly eaten through in places.

SUGAR: FIELD REPORTS.

The Southern Field Assistant (Mr. J. C. Murray) reports under date 24th April, 1924:—

Sharon.

In this locality the cane is growing strongly, and there is every prospect of a fairly heavy harvest. Crops are, comparatively, free from disease, and a minimum of damage is being caused by insect pest or root destroying fungi. Varieties that have a good appearance are—Q.813, H.Q.285, N.G.16, N.G.15, M.1900 Seedling.

Farmers are getting satisfactory results from bone dust as a fertiliser. Growers are advised to keep a keen lookout for symptoms of Yellow Stripe (Mosaic), and eradicate suspicious looking stools of cane. Analyses of these Sharon soils show them to be low in potash. Farmers are advised to do more green manuring. By ploughing in such crops as Mauritius bean and cowpea they greatly add to the nitrogen store in the soil. In such crops as these, nodule forming bacteria draw nitrogen supplies from the atmosphere. A dressing of lime is beneficial in conjunction with green manure crops. Lime would probably be beneficial on most of the forest and alluvial soils of the Bundaberg district, though on the heavy volcanic scrub soils it does not give results.

Branyan.

The area under cane is gradually being extended. The chief difficulty is getting cane to the Bingera mill. Transport will involve a fair amount of handling, as both punting and tram haulage will be necessary. Crops are looking well, and farmers consider that sugar-growing here will pay. Most of this land has for many years been used for grazing purposes, therefore it is probable that a few years must elapse before it reaches the maximum producing capacity. Q.813 is making an excellent showing. Lime would be beneficial on these soils.

Millbank.

The farmers should take heavy crops off Millbank this season. The cane is healthy and well grown, and cultivation and farming generally are good. Here, as at Branyan, the growers are handicapped by long haulage with horse teams to Bundaberg railway station. It is suggested that water carriage to Millaquin would be much cheaper and more convenient.

Farmers are recommended to use lime and green manures on these soils, the former especially, as lime not only makes dormant plant food available, but it has a beneficial effect on root-destroying fungi. Fungus parasites appear to be more frequently met with in alluvial than in volcanic soils.

Childers.

This district should cut very heavy crops this season. Since January the rainfall has been abundant and well distributed, and the cane has responded accordingly. There are only two mills in this district now, so that it is probable an early start will have to be made to get through the crop. A number of growers have a quantity of standover which will be available for early cutting.

A certain amount of leaf disease is in evidence, principally showing in the H.Q.77, and Black Innis; M.1900 Seedling is also showing disease, although not to any marked extent. The leaf hopper is numerous this year, and may be the cause, to a certain degree, of the spread of infection. However, there is nothing definitely known as to the agent that causes the disease or how it spreads. A cane variety that is making a great showing is H.Q.285. Mr. Broadhurst has had it since about 1914, but it has never been very widely distributed in the Childers district. However, the majority of the growers now appear to be planting this variety and are pleased with the progress it is making.

Some farmers are at present having drainage difficulty. The soil is saturated, water in some instances oozing out on the surface high up the slopes. It is surprising to note that some of the springs, after the water has seeped through the red soil, are quite fresh and almost free from chloride.

In some instances in this district very deep planting is being done. It is a mistake, however, to plant more than 8 or 9 inches deep in this soil. The plant may, and probably will, strike well, but there are not sufficient supplies of food in the subsoil to sustain subsequent growth. Also, heavy rain after planting may place a

great deal of covering on the plants. Plant roots can generally be kept in the soil by adjusting the cultivators so that the soil is thrown away a little from the cane at each cultivation period.

Dallarnil.

The canegrowing area has been extended considerably. Heavy rains have fallen here since January, and the cane consequently is looking well. There is no doubt about the quality of the Dallarnil scrub soil. The cane is so well advanced now that frosts, if they occur, are not likely to do much damage. Farmers here are advised to go in as much as possible for early spring planting and use quick-growing and early-maturing varieties. A good standover cane is also to be recommended. Canes to be recommended are Q.813, H.Q.285, and E.K.1. Varieties doing well at Dallarnil beside the three mentioned are Rappoe, Uba, Striped Singapore, D.1135, and M.1900 Seedling.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF MARCH, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALLS DURING MARCH, 1923 AND 1924, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Mar.	No. of Years' Records.	Mar. 1923.	Mar. 1924.
North Coast.	In.		In.	In
Atherton	9·06	23	11·09	6·71
Cairns	18·14	42	22·03	15·81
Cardwell	16·09	52	7·27	25·37
Cooktown	15·40	48	29·91	12·68
Herberton	8·28	37	5·98	6·85
Ingham	15·76	32	5·79	13·35
Innisfail	25·79	43	22·51	41·96
Mossman	18·86	15	18·14	13·59
Townsville	7·63	53	0·66	12·76
Central Coast.				
Ayr	7·02	37	0·63	4·42
Bowen	5·83	53	1·11	3·10
Charters Towers	3·69	42	6·50	6·24
Mackay	12·27	53	4·73	4·31
Proserpine	11·95	21	4·75	5·51
St. Lawrence	5·85	53	0·17	2·66
South Coast.				
Biggenden	4·10	25	2·47	3·17
Bundaberg	5·32	41	0·48	3·09
Brisbane	5·76	73	2·34	3·45
Childers	4·87	29	0·68	4·80
Crohamhurst	11·51	31	6·18	8·51
Esk	4·85	37	5·85	4·78
Gayndah	3·25	53	2·02	2·26
Gympie	6·19	54	2·50	4·79
Glasshouse Mts.	8·99	16	5·19	...
Kilkivan	3·98	45	1·79	3·37
Maryborough	6·23	53	2·41	7·37
South Coast—continued:	In.		In.	In.
Nambour	9·31	28	3·71	6·28
Nanango	3·40	42	4·65	3·60
Rockhampton	4·85	37	0·55	5·33
Woodford	8·03	37	4·64	6·47
Darling Downs.				
Dalby	2·70	54	1·53	3·18
Emu Vale	2·55	28	0·61	2·53
Jimbour	2·63	36	2·70	1·81
Miles	2·66	39	0·35	4·64
Stanthorpe	2·75	51	2·13	1·88
Toowoomba	3·85	52	1·33	5·27
Warwick	2·64	59	1·70	2·52
Maranoa.				
Roma	2·79	50	1·76	3·11
State Farms, &c.				
Bungeworgorai	1·53	10	0·56	3·48
Gatton College	3·36	25	2·19	2·83
Gindie	2·80	25	2·62	0·16
Hermitage	2·39	18	0·52	2·38
Kairi	8·28	10	11·72	1·21
Sugar Experiment Station, Mackay	11·21	27	2·82	3·89
Warren	2·47	10	0·00	4·92

NOTE.—The averages have been compiled from official data during the periods indicated; but the totals for March, 1924, and for the same period of 1923, having been compiled from telegraphic reports, are subject to revision.

J. H. HARTSHORN,
Acting State Meteorologist.

REPORT ON EGG-LAYING COMPETITION, Q.A.H.S. AND C., MARCH, 1924.

The competition commenced on 5th April, 1923, and concluded 31st March, 1924. It has been again a medium of establishing records, proving that the quality of the competing birds, both individually and collectively, is still on the up grade. The conditions attending this last test were not at all favourable. A fairly long spell of cold winds for the best part of the season checked egg production. The birds also had a rather bad time during the heat wave on 19th and 20th December. However, notwithstanding the drawbacks, the final figures were satisfactory. Mr. R. Burne's E. bird started to lay on 7th April, and missed only seventeen days to 31st March, thus establishing a world's record by laying 343 eggs in 362 days of the competition. In the light breed, Mr. C. H. Singer's B. bird put up a record with 333 eggs for the same period. In the other breeds, C. bird in the Ancona pen laid 282 eggs. Seven of the leading pens have been held over until the evening of 4th April to complete the full 365 days' score. Records:—

Competitors.	Breed.	March.	Total.
LIGHT BREEDS.			
*C. H. Singer	White Leghorns	126	1,600
*W. and G. W. Hindes	Do.	117	1,585
*N. A. Singer	Do.	119	1,583
*Oakleigh Poultry Farm	Do.	71	1,396
*Ancona Club	Anconas	100	1,363
*H. P. Clarke	White Leghorns	82	1,330
*S. L. Grenier	Do.	82	1,324
*Mrs. L. Andersen	Do.	61	1,285
*R. C. J. Turner	Do.	50	1,280
*Beckley Poultry Yards	Do.	50	1,276
*J. W. Newton	Do.	35	1,249
*Geo. Williams	Do.	87	1,240
*O. Goos	Do.	40	1,191
*C. A. Goos	Do.	66	1,179
*J. Purnell	Do.	89	1,166
*Rock View Poultry Farm	Do.	20	1,163
*Arch. Neil	Do.	68	1,155
*Bathurst Poultry Farm	Do.	25	1,130
*J. W. Short	Do.	51	1,109
*Mrs. R. E. Hodge	Do.	51	1,106
F. Sparsholt	Do.	66	1,092
*J. M. Manson	Do.	36	1,087
*H. Fraser	Do.	56	1,081
*N. J. Nairn	Do.	56	1,048
G. E. Rogers	Do.	63	1,025
*A. C. G. Wenck	Do.	20	1,024
Jas. Hutton	Do.	45	995
W. A. and J. Pitkeathly	Do.	55	987
W. and G. W. Hindes	Brown Leghorns	55	984
G. Marks	White Leghorns	38	980
E. Ainscough	Do.	52	972
W. Becker	Do.	42	950
Jas. Harrington	Do.	44	947
C. Quesnell	Do.	48	947
*Mrs. E. White	Do.	35	910
Parisian Poultry Farm	Do.	35	888
Chapman and Hill	Do.	47	880
Jas. Earl	Do.	51	876
HEAVY BREEDS.			
*R. Burns	Black Orpingtons	118	1,504
*Mrs. A. E. Gallagher	Do.	110	1,426
*Jas. Ferguson	Chinese Langshans	85	1,348
*W. Becker	Black Orpingtons	57	1,341
*Jas. Potter	Do.	51	1,330
*E. Walters	Do.	82	1,228
*T. Hindley	Do.	52	1,519

EGG-LAYING COMPETITION—*continued.*

Competitors.	Breed.	March.	Total.
	HEAVY BREEDS—*continued.*		
*Jas. Hutton	Black Orpingtons	60	1,181
*Parisian Poultry Farm	Do.	51	1,179
*Mrs. A. Kent	Do.	26	1,175
*E. F. Dennis	Do.	71	,169
H. B. Stephens	Do.	70	1,118
*C. C. Dennis	Do.	48	1,104
J. R. Douglas	Do.	50	1,097
*R. Holmes	Do.	58	1,095
*H. M. Chaille	Do.	27	1,072
*J. H. Jones	White Wyandottes	51	1,070
Beckley Poultry Yards	Black Orpingtons	61	1,046
W. F. Solman	Do.	31	1,046
R. Conochie	Do.	60	1,043
W. F. Ruhl	Do.	55	1,015
G. E. Rogers	Do.	53	1,009
Rev. A. McAllister	Do.	45	960
V. J. Rye	Do.	60	923
Jas. Ferguson	Plymouth Rocks	34	888
F. J. Murphy	Black Orpingtons	57	888
W. G. Badcock	Chinese Langshans	46	855
Jas. Ferguson	Rhode Island Reds	40	730
Mos. Stephens	Black Orpingtons	15	660
Totals	..	3,858	75,078

* Indicates that the pen is being single tested.

DETAILS OF SINGLE HEN PENS.

Competitors.	A.	B.	C.	D.	E.	F.	Total.
			LIGHT BREEDS.				
C. H. Singer	239	333	268	233	242	285	1,600
W. and G. W. Hindes	254	275	265	227	285	279	1,585
N. A. Singer	227	277	301	288	245	245	1,583
Oakleigh Poultry Farm	221	248	233	225	252	217	1,396
Ancona Club	203	245	282	191	200	242	1,363
H. P. Clarke	250	164	247	204	226	239	1,330
S. L. Grenier	187	238	260	219	203	217	1,324
Mrs. L. Andersen	191	222	234	225	217	196	1,285
R. C. J. Turner	209	211	204	207	201	248	1,280
Beckley Poultry Farm	207	191	198	235	225	220	1,276
J. W. Newton	235	225	200	172	205	212	1,249
Geo. Williams	232	240	200	193	185	190	1,240
O. Goos	187	210	212	196	184	202	1,191
C. A. Goos	201	215	143	217	193	210	1,179
J. Purnell	205	201	175	189	213	183	1,166
Rock View Poultry Farm	213	234	214	198	160	144	1,163
Arch. Neil	174	195	179	211	210	186	1,155
Bathurst Poultry Farm	193	196	157	221	183	180	1,130
J. W. Short	210	166	200	154	219	160	1,109
Mrs. R. E. Hodge	153	188	184	202	207	172	1,106
J. M. Manson	164	154	196	223	180	170	1,087
H. Fraser	183	157	185	189	202	165	1,081
N. J. Nairn	176	163	200	175	153	181	1,048
A. C. G. Wenck	187	169	134	184	150	200	1,024
Mrs. E. White	106	161	190	186	167	100	910

EGG-LAYING COMPETITION—*continued.*

DETAILS OF SINGLE HEN PENS—*continued.*

Competitors.	A.	B.	C.	D.	E.	F.	Total.
HEAVY BREEDS.							
R. Burns	254	275	214	204	343	214	1,504
Mrs. A. E. Gallagher	225	249	243	242	233	234	1,426
Jas. Ferguson	228	258	212	214	204	232	1,348
W. Becker	219	232	236	244	202	208	1,341
Jas. Potter	200	255	217	206	223	229	1,330
E. Walters	246	232	189	165	201	195	1,228
T. Hindley	200	210	212	203	192	178	1,195
Jas. Hutton	231	166	212	213	158	201	1,181
Mrs. A. Kent	169	228	156	251	185	186	1,175
Parisian Poultry Farm	172	200	194	215	198	200	1,179
E. F. Dennis	204	214	206	194	145	206	1,169
C. C. Dennis	197	209	141	186	188	183	1,104
R. Holmes	134	170	179	178	212	222	1,095
H. M. Chaille	177	200	195	169	155	176	1,072
J. H. Jones	193	200	186	144	145	202	1,070

J. K. MURRAY, Principal.

THE ZILLMERE EGG-LAYING COMPETITION FOR APRIL.

Exactly 1,800 eggs were laid at the above competition, which commenced on 1st April, an average of 10 eggs per bird for the month. The 111 White Leghorns averaged 10·6, the 48 Black Orpingtons 12, and the 21 other varieties 2 eggs per bird. Some birds have not yet commenced laying, a few pullets being hardly forward enough. No. 146 Black Orpington had to be replaced, owing to her laying abnormal eggs; and No. 112 was broody for a few days.

WHITE LEGHORNS.

Pen No.	Owner.	Total.	Pen No.	Owner.	Total.
65	E. Tracey	24	87	Enroh Pens	19
59	A. Staib	23	18	J. T. Webster	18
78	M. F. Newberry	23	32	W. and G. W. Hindes	18
20	A. Hodge	22	43	P. F. Adams	18
55	J. Hutton	22	92	C. A. Hodgson	18
66	E. Tracey	22	97	K. A. Sommerlad	18
90	R. Duff	22	64	E. Tracey	16
93	C. A. Hodgson	22	75	E. C. Raymond	16
103	P. F. Oakleigh	22	29	M. H. Campbell	15
6	H. T. Pember	21	50	J. Earl	15
12	W. J. Berry	21	51	J. Earl	15
19	A. Hodge	21	70	J. R. Wilson	15
67	Kidd Bros.	21	71	J. R. Wilson	15
80	J. Purnell	21	76	M. F. Newberry	15
85	Enroh Pens	21	81	J. Purnell	15
89	R. Duff	21	101	A. S. Walters	15
100	A. S. Walters	21	22	A. Neil	14
102	A. S. Walters	21	28	M. H. Campbell	14
57	J. Hutton	20	52	G. E. Rogers	14
104	P. F. Oakleigh	20	56	J. Hutton	14
21	A. Hodge	19	86	Enroh Pens	14
27	H. T. Britten	19	35	J. L. Chapman	13
31	W. and G. W. Hindes	19	40	R. C. Cole	13
42	R. C. Cole	19	60	A. Staib	13
44	P. F. Adams	19	61	P. F. Carinya	13
49	J. Earl	19	79	J. E. G. Purnell	12
54	G. E. Rogers	19	105	P. F. Oakleigh	12
[illegible]	W. Wakefield	19	26	H. T. Britten	11

THE ZILLMERE EGG-LAYING COMPETITION—*continued.*

WHITE LEGHORNS—*continued.*

Pen No.	Owner.	Total.	Pen No.	Owner.	Total.
30	M. H. Campbell	11	17	J. T. Webster	2
82	W. Wakefield	11	24	A. Neil	2
1	F. J. Williams	10	46	R. C. J. Turner	2
88	R. Duff	10	83	W. Wakefield	2
173	S. L. Grenier	10	106	W. L. Howard	2
9	H. Sturman	8	2	F. J. Williams	1
36	J. L. Chapman	8	38	H. Fraser	1
73	E. C. Raymond	8	47	R. C. J. Turner	1
16	J. T. Webster	7	96	G. Williams	1
74	E. C. Raymond	7	108	W. L. Howard	1
95	G. Williams	7	5	H. T. Pember	0
174	S. L. Grenier	7	7	H. Sturman	0
10	W. J. Berry	6	8	H. Sturman	0
99	K. A. Sommerlad	5	11	W. J. Berry	0
172	S. L. Grenier	5	14	G. Marks	0
4	H. T. Pember	4	15	G. Marks	0
33	W. and G. W. Hindes	4	23	A. Neil	0
45	P. F. Adams	4	34	J. L. Chapman	0
48	R. C. J. Turner	4	37	H. Fraser	0
62	P. F. Carinya	4	53	G. E. Rogers	0
72	J. R. Wilson	4	58	A. Staib	0
3	F. J. Williams	3	63	P. F. Carinya	0
25	H. T. Britten	3	68	Kidd Bros.	0
39	H. Fraser	3	91	C. A. Hodgson	0
41	R. C. Cole	3	94	G. Williams	0
69	Kidd Bros.	3	98	K. A. Sommerlad	0
77	M. F. Newberry	3	107	W. L. Howard	0
13	G. Marks	2			

BLACK ORPINGTONS.

124	T. Brotherton	26	113	W. R. Wilson	10
143	F. P. Cummings	25	155	J. Hutton	10
115	G. L. Campbell	24	128	E. Walters	9
126	T. Brotherton	24	138	W. S. Adams	9
110	T. Fanning	23	111	T. Fanning	8
114	W. R. Wilson	23	153	Enroh Pens	8
144	F. P. Cummings	23	149	E. C. Raymond	7
119	H. M. Chaille	22	125	T. Brotherton	6
139	J. Pryde	22	127	E. Walters	6
142	F. P. Cummings	22	137	W. S. Adams	6
156	J. Hutton	22	134	C. C. Dennis	5
109	T. Fanning	21	135	C. C. Dennis	5
117	G. L. Campbell	21	136	W. S. Adams	5
112	W. R. Wilson	20	132	G. E. Rogers	4
116	G. L. Campbell	20	123	J. Potter	3
122	J. Potter	18	145	P. Y. Everlay	3
129	E. Walters	17	152	Enroh Pens	3
120	H. M. Chaille	16	118	H. M. Chaille	2
133	C. C. Dennis	16	121	J. Potter	1
148	E. C. Raymond	14	140	J. Pryde	1
147	P. F. Everlay	13	150	E. C. Raymond	1
131	G. E. Rogers	12	141	J. Pryde	0
154	J. Hutton	12	146	P. Y. Everlay	0
130	G. E. Rogers	11	151	Enroh Pens	0

OTHER VARIETIES.

175	P. Y. Everlay (B.L.)	12	163	A. S. Walters (B.R.)	0
159	P. F. Messines (R.I.R.)	9	164	A. S. Walters (B.R.)	0
167	W. H. Forsyth (S.W.)	8	165	A. S. Walters (B.R.)	0
166	W. H. Forsyth (S.W.)	6	168	W. H. Forsyth (S.W.)	0
176	P. Y. Everlay (B.L.)	3	169	J. Pryde (Lang.)	0
157	P. F. Messines (R.I.R.)	2	170	J. Pryde (Lang.)	0
171	J. Pryde (Lang.)	1	177	P. Y. Everlay (B.L.)	0
158	P. F. Messines (R.I.R.)	0	178	J. Ferguson and Son (B.L.)	0
160	T. C. Ollier (B.R.)	0	179	J. Ferguson and Son (B.L.)	0
161	T. C. Ollier (B.R.)	0	180	J. Ferguson and Son (B.L.)	0
162	T. C. Ollier (B.R.)	0			

SUGAR PESTS AND DISEASES IN THE MACKAY DISTRICT.

The Director of the Bureau of Sugar Experiment Stations (Mr. H. T. Easterby) has received the following report on Pests and Diseases in the Mackay district from Mr. W. Cottrell Dormer:—

Survey of the districts of Pinnacle, Owen's Creek, Finch Hatton Gorge, Hatton, Netherdale, Plane Creek, Mount Christian, and Carmilla.

DISEASES.

Knife Cut.

I found that this disease, or weakness, of D.1135 cane (Bundaberg) was or had recently been prevalent throughout the districts visited. I took special care in this connection to note whether the disease was, or was not, cumulative, and if it were propagated by seed. As a result of my observations and inquiries I do not think that the disease, if disease it is, is carried in any way by seed. Again, the fact that all wounds on any single stick are invariably on the same side of that stick seems to me to make the theory that the disease is carried by insects rather doubtful. However, "Knife Cut" is capable of inflicting severe damage to a crop both in tonnage and in sugar content. This was particularly evident on two farms near Sarina—Mr. T. Hughes and Mr. R. McKie.

Mosaic.

This disease was observed on one farm only—that of Mr. P. F. Wentzel, at Carmilla. Mr. Wentzel is keenly interested in the propagation of promising varieties. I noticed that at least 50 per cent. of H.168/04 was diseased with Mosaic. The affected stools, or most of them, were fully 18 inches to 24 inches shorter in top than the healthy stools. In some stools only a few sticks were affected, showing that these had caught the disease since planting. This small plot of diseased cane was surrounded by all of the abovenamed varieties and adjoined larger blocks of H.Q.426 and of M.1900 Seedling. I could not find one stool of these showing any signs of disease. However, this does not mean to say that these varieties are not susceptible. Incidentally, I would like to mention that the E.K.28 was looking remarkably vigorous and was making thick, solid cane rather more quickly than the surrounding varieties. The original stools of M.168/04, which supplied plants last year for the above canes, were next examined. Here the cumulative stunting action of Mosaic was well in evidence. The disease, though infectious, had only spread to one neighbouring stool of 7 R.428. It was, of course, pointed out to the grower that all stools of the variety M.168/04 should be ploughed out after the cutting. As it is not a very promising variety, it would not be worth his while to risk perpetuating the disease by keeping apparently healthy stools. I also advised the various growers I met in the district to call on Mr. Wentzel to see for themselves the disease in question. Whilst going through the farm I took special notice of sap-sucking insects on the cane. The following were observed:—Leaf Hopper (*Perkinsiella saccharicida*), Linear Bug (*Phœnacantha*), Leaf Hopper (*Astorga saccaricida*), Leaf Hopper (*Tetigonid*), Longwinged Leaf Hopper (*Sardis* sp.), and some Heteropterous larvæ, the imaginal form of which is unknown to me. The most plentiful of these was the first mentioned. This was present in tremendous numbers in all stages from egg to adult. I have never before seen them so plentiful. The Linear bug was also much in evidence. The importance of these insects lies, not in their direct injuriousness to the cane plant, which is but slight owing to their many natural enemies, but in their potentiality as disease carriers. I also noticed great numbers of a very minute mite (Accarid) below the cane leaf sheaths. These may have been subsisting on the fermenting juices and cells which are generally present at this part of the cane. Soil was a well-drained sandy brown loam near the banks of the Carmilla Creek.

Bleeding.

Two cases of death of ratoons owing to "bleeding" were described to me at Netherdale. I was unable to attribute any cause to this ailment, which appeared to have caused stools to dry up after the cutting last year. The varieties affected were H.Q.426 and D.1135, one man having lost two acres of the latter.

INSECT PESTS.

Lepidoderma albohirtum Waterh.—The notorious grey-back cane grub was found distributed throughout all the districts visited with the exception of Carmilla and Mount Christian. One notable feature of this distribution is that the worst of the damage done by this pest is invariably found in the loose, friable, and often sandy

soils of the creek and river flats. This applies especially to the Garget, Owen's Creek, Pinnacle, and Finch Hatton districts. The importance of this will be quickly realised after reading the next few lines. On Wednesday, 26th March, I visited Owen's Creek, and incidentally went through Mr. J. H. Morris's farm. I found this gentleman deeply interested in all work aiming at grub control. He had a bisulphide pump and some carbon bisulphide, and had treated several small plots and had obtained very good results, as much as 80 per cent. to 90 per cent. mortality being observed amongst the grubs. Accompanied by Mr. Morris and by Messrs. Thorning Bros., I selected a spot and injected about 1 chain with ¼-oz. doses on both sides of stool. The soil was friable but damp, and not in the best condition for fumigation, as it contained a percentage of wet clay. However, two days later Mr. Morris examined nine stools. Only five sheltered grubs. His findings were as follows:—Dead, 60 per cent.; sick, 20 per cent.; healthy, 20 per cent. This meant an eventual mortality of 80 per cent. Thus, if such results could be obtained in Mr. Morris's rather damp soil (I did not anticipate a bigger mortality than about 50 per cent.), what results could be expected in more sandy soils where the worst of the damage is done? The cost of fumigation by hand with carbon bisulphide runs from about £4 to £4 10s. per acre. Later, if para-dichlor. comes up to expectations, fumigation will be a great deal cheaper. When cane is fairly big, the more erect varieties are naturally the easiest to treat.

Grubs were found at their worst in the Pinnacle and Owen's Creek districts. After having become accustomed to seeing an occasional first or young second-stage grub round about the Mackay districts, I was very much taken by surprise when Mr. H. McLean and Mr. D. Bourke, of Pinnacle Plain, turned up some very large and very active third-stage grubs. Last year about 14 acres of Badila were completely destroyed on the farm of which the latter of the abovementioned growers has charge. The soil is a loose black alluvial loam, and, in plant cane at least, would prove quite suitable for fumigation. Several of the farms situated on the loose alluvial flats of Plane Creek are similarly affected. Mr. McLean, of Pinnacle, recently cut down all feeding trees on his creek frontage and states that grub damage on his farm has thus been minimised to a great extent.

Other Grubs.

One young second-stage grub of *Lepidiota frenchi* was found on a farm in the Owen's Creek district. As the season is getting rather late, practically all third-stage grubs of this species have "gone down" deep into the soil to hibernate previous to pupating. The single grub found was under a stool of D.1135. *Anomala australaside* was represented in my finds by a single second-stage grub found under a stool of Clark's Seedling on an alluvial flat at Owen's Creek. Several large third and second stage grubs of *Dasygnathus australis* were found at Pinnacle and Owen's Creek, under stools of Badila and of D.1135 respectively (47, 50). A small *Heteronyx* sp. was found in all stages throughout districts visited. These are of no economic importance.

Other Insect Pests.

Most of the sap-sucking insects have already been noticed under Mosaic. The first of these mentioned, *Perkinsiella saccharicida*, is the common little greyish-coloured leaf hopper one sees in almost any canefield. However, it was nowhere so plentiful as it was at Carmilla. The Linear bug, though so very common in the North, was only observed at Carmilla, though doubtlessly it occurs in the other districts visited. The next hopper mentioned, *Astorga saccharicida*, a rather broad and flattened winged insect, measuring about ¼ inch in length and of a brownish colour, is also common enough throughout the district. Mealy bugs, *Pseudococcus calceolariæ*, is another very common sap-sucking insect. It is to be found most plentifully on varieties with loose leaf sheaths such as D.1135. Evidence of damage of the large Moth Borer (*Phragmatiphila truncata*) was obtained everywhere I went. The caterpillars were actually found attacking a block of Shahjahanpur 10 on Mr. R. McKie's farm, near Sarina. This pest has also frequently been reported to me as attacking varieties Uba and D.1135 which, on account of their hard rind, are seldom favoured by the beetle borer (*Rhabdocnemis obscurus*). This last pest is also well distributed according to descriptions given by growers. However, none of these borers do any serious damage or call for active control measures. I did not actually find the beetle borer in any stage, and have had to depend solely on descriptions given me by growers of grub and damage. Wire worms, *Monocrepidius* sp., though well distributed, do but very slight damage and only in low-lying fields. White ants, *Termes* sp., occasionally cause some supplying, but they seem only to occur in fields containing old roots or stumps, though occasionally they have been known to form a

nest below a stool and hollow out all the sticks. The large white ant of the Lower Burdekin, *Mastotermes darwiniensis,* was not found anywhere and apparently does not occur in the Mackay districts. The Army Worm, *Cirphis unipuncta,* was mentioned by growers at Finch Hatton and at Carmilla. The damage done by them, however, was but slight compared to that often experienced in the Cairns district. Another, but a very minor, Lepidopterous pest was observed at Finch Hatton and at Sarina. This is *Melanitis leda,* a common brown butterfly, whose green caterpillars usually feed on grass but sometimes on cane leaves. Another sap-sucking insect which I omitted to mention above is *Aleurodes berghi,* a colony of which I found on a leaf of D.1135 at Carmilla, a very small grey insect of the leaf hopper tribe (*Homoptera*). The female has a peculiar habit of laying her eggs in a circle, turning about on the one spot to do so. This pest is of very minor importance. At Finch Hatton Mr. A. Bergmann gave me a description of some Dipterous larvæ which had attacked his plants last year and prevented them from striking. They were small grey maggots about ⅜ inch long and would cluster all around the nodes, apparently to feed on the young root buds.

Wallabies and Other Pests.

On the whole, wallabies seem to have been the most serious pest the growers of all outlying districts have had to put up with. Practically all of these growers have lost from 1 to 4 acres. In some parts the wallabies have been known to actually dig the set right out when attacking very young plant cane. One grower, Mr. R. McKie, of Sarina, mentioned that they were wont at times to camp in the tall cane, when they would pull the cane about and destroy it wantonly and thus make playgrounds out of some fields. Many farmers have resorted to shooting and trapping, whilst others rely solely upon dogs. Several growers mentioned have destroyed as many as fifty and sixty wallabies during last season. At Finch Hatton Gorge it was reported that cockatoos had lately done serious damage on two farms. Mr. P. Connolly, of Carmilla, mentioned having had 6 acres of young plant Badila cane destroyed by grey kangaroos. Both of these pests are, to the best of my knowledge, new to cane. Scrub turkeys are also reputed with doing rather serious damage in places in the Finch Hatton and Plane Creek districts. However, none of these animals do much damage in normal good years. Coots do slight damage in most of the creek districts, especially on farms situated near swamps.

Digger Wasps and other Grub Destroyers.

The most common digger wasp (*Campsomeris tasmaniensis*) was observed at Sarina and at Carmilla. Carabid beetles and larvæ (*Gnathaphanus pulcher,* &c.) occur in the soil throughout the cane districts.

Cane-killing Weed.

Something of a scare seems to have started on the canefields of the upper reaches of Carmilla Creek. A certain weed is to be found growing in these fields amongst the cane. Here and there may be seen small patches of very stunted cane surrounded by perfectly healthy stools. In these patches the weed thrives and has, therefore, been put down by the Carmilla growers as being the cause of the stunting.

Survey of the districts of Racecourse, Mackay and Palms, Farleigh, Pleystowe, and Marian.

DISEASES.

All these districts I found remarkably free from disease. At the Mackay Experiment Station, Mr. Keogh, the Chemist in charge, pointed out a few stools of D. 1457 affected by Leaf-stripe disease (*Solorospora sacchari* Miz.), and also some stools suffering from Mosaic disease. These stools have all been carefully destroyed. I noticed what I took to be Mosaic disease in a whole field of cane near the Palms Mill, and also in a small block of Q. 813 belonging to Mr. F. Martin, whose farm is at Mandarana, near Farleigh. Knife-cut disease appears to have been prevalent last year in D. 1135 growing at Devereaux Creek, in the Marian district. Another possible disease is that which many farmers call Bunchy Top. This is a crumpling and twisting of the growing cane leaves about the heart in such a way as to make the progress of this part of the cane very difficult. However, the curled leaves die and rot after a time and the cane seems to recover. This is mostly to be found in 1900 Seedling, though Q. 813 and other varieties are also susceptible. This so-called disease may be due to the sudden breaking of the drought and consequent fast growth of the cane.

PESTS.

Grubs.

The most easily found cane-grub at present is that of *Lepidiota frenchi* Blkb. These I found scattered throughout the districts visited, about 99 per cent. of them being in the third stage and ready to go down to hibernation. As this grub has a two-year life cycle it does most of its damage during the warm months of the year, *i.e.*, after its first winter under ground. Actual evidence of damage was obtained in several places. Cane is generally affected by this grub when in the young ratoon stage, it then becomes stunted and is at times killed outright. At the Experiment Station several patches of Q. 813 and of D. 1135 were badly stunted in this way. Mr. J. McDonald has only recently had to plough out about 8 or 9 acres of ratoon for this reason. About two acres of Q. 813 belonging to Mr. G. Anable, of Racecourse, large patches of Q. 813 in a field belonging to Mr. A. N. Willis, of Te Kowai, and about 2 square chains of Clark's Seedling belonging to Mr. J. McKay, of Palingra, were rendered useless by this grub. In each case excepting the last the soil was of a heavy consistency and unsuitable for fumigation. However, Mr. McKay's soil could be treated with certain success, it being a very open sandy loam. Mr. McKay had already put down a top dressing of common salt at the rate of 575 lb. to the acre, as an experiment, but a live grub was found under a stool in spite of this. Grubs of *Lepidoderma albohirtum* Waterh., "the greyback," were not at all easy to find, yet they have been responsible for a great deal more damage. Complaints were lodged against this notorious pest in several quarters. Thus the Greyback grub is well distributed also. Mr. Watson, of Racecourse, stated having lost about £2,000 worth of cane and labour through grubs. In the worst of the grub-infested spots the soil was found to be quite suitable for fumigation with either para-dichlor or carbon bisulphide, the damage being mostly done on the sandy river flats or in well drained and open soil amongst the forest hills, such as Habana and Devereaux Creek. In every case the farmer was advised as to method of procedure in fumigation. Endeavour was made also, to point out the main differences between true Melolonthid cane grubs, which feed on the living cane roots, and other grubs which only feed on old sets or dead stools and very seldom do any damage. One very simple thing to remember in this connection is that no true cane grub (such as *L. albotirtum* and *L. frenchi*) will ever under any circumstances crawl on its belly. Another thing which growers could remember is that it is an exceedingly rare thing to find a true cane grub under old wood. I mention this because all grubs appear to be the same to the uninitiated eye.

By following ploughs and digging holes I found several other species of grubs, some of which are of interest. *Heteronyx* sp. (*sollicitus*?) is exceedingly common and is to be found throughout the districts in larval, pupal, and imaginal stages; it is of no economic importance, as it is a very tiny brown cockchafer often seen flying to light. *Dasygnathus australis* is also well distributed; was found in each district in the larval stage; in each case it was found eating dead sets, dead roots, or old wood in the soil. *Anoplognathus* sp. was also found feeding on old wood; the species was quite unknown to me and was found at Marian; a specimen was sent to the entomologist at Meringa. Another species of *Anoplognathus* was found under weeds in a sandy loam on river bank at Racecourse. *Lepidiota* 615 (?) was found feeding on the roots of Malagache in very sandy soil near the Pioneer Bridge; the grubs have previously been recorded from sandy river beds, but I fancy that this is the first record of their attacking sugar-cane; only one grub was found. Two grubs of *Horonotus optatus* were found in the same field as *Lep.* 615, and the remarks concerning this latter also apply here. Grubs and adults of *Noso flavipennis* are to be found through the districts, and a species of *Haplonycha* (unknown to me) is to be found in places. One first-stage larva and a female of the "Elephant" Beetle (*Xylotrupes australicus* Thoms.) was found while digging beneath some old wood on a farm near Croker's Hill.

A more serious pest than any of these is the Wire Worm (*Mono. crepidius* sp.) This insect, which attacks the eyes of sets and thus prevents "striking," occurs plentifully in all low-lying cane fields. It does its damage mostly during the colder months. The experience of growers seems to point to lime as a good repellent. Cases were mentioned to me that where cowpea was used as a green manure wire worms were worst. It is possible that cowpea might prove attractive to the *Monocrepidius* beetle, who might be prompted to deposit eggs amongst its roots. But this remains to be tested by experiment. However, some growers are of opinion that the beetle lays her eggs on the young pea pods and that the larvæ develop in these pods, so that when the crop is ploughed in they attack the sets in seeking further nourishment. This idea is quite erroneous, as the wire worms spend the whole of their larval state in the soil. The borings that growers see in the pea pods (which, it seems, led to this false idea) are caused entirely by caterpillars of moths and by insects other than wire worms. The larvæ have a two or three years' life

cycle, so that possibly they do more damage some years than others at regular intervals in the same way as grubs of *L. frenchi.*

In every field that I have visited I have noticed beetles of *Gonocephalum* sp. (*torridum* or *carpentercæ* or both) running about the soil about cane stools. The larvæ of these beetles are small cylindrical wire worms attaining a length of ¾ inch. They feed upon the young roots of growing cane, piercing them with numerous small pits, thus leaving the roots exposed to the many root diseases which may be present in the soil. *Pentodon australis,* a small Dynastid beetle, is quite common about here, and is frequently to be seen at bright lights. At Farleigh I found seven specimens under the one electric light. This suggests light traps as a form of control should this pest ever become serious. During most of my travelling I carried a specimen with me, and the majority of growers recognised it as a beetle usually attracted to their lamps. However, only one farmer had ever noticed the beetle at work. This was Mr. C. Dolby, near Croker's Hill, on the main Farleigh road. He stated having found the beetle in holes gnawed at the base of stalks of Clark's Seedling about 2 inches below the surface of the soil. This was in October last. He was prompted to look when he noticed that odd sticks were inexplicably yellowing and dying. At Te Kowai, on the Palms Estate, I found similar injury at the base of sticks of standover Clark's Seedling. In both instances holes were dug under and about old affected stools, but no grubs could be found and the beetles had left. Grasshoppers (*Locusta danica, L. australis,* &c.) were plentiful in all districts, but were doing very slight injury to the foliage. Mention was made to me in most parts of pest attacks of the Army Worm (*Cirphis unipuncta* Haw.), but I did not actually see any larvæ or moths. The beetle-borer (*Rhabdocnemis obscurus* Boisd.) is, according to descriptions of growers, well distributed throughout the districts. However, the slight damage it does now is no greater than that which was done by it ten or twelve years ago, so that it is very unlikely that borers will ever become serious. One or two farmers in each district gave me vague descriptions of moth borers and of longicorn borers. In this connection I have advised growers to always keep handy in their houses a well-corked pickle bottle containing a fair quantity (say, half gallon) of methylated spirits, in which they could throw any borer, grub, or other pest of interest, so that whenever an officer of the Entomological and Pathological Divisions of the Bureau was passing through the district they could produce the pest on which they want information. Of course if they could send specimens to the Entomological Laboratory at Meringa it might be better, but it is not always convenient for growers to do this. *Perkinsiella saccharicida* and other sap-sucking pests, including the Mealy Bug, are to be found in every locality, but seem to be kept well in check by natural enemies. The Leaf Miner (*Cosmopteryx* sp.) and the Bud Moth (*Spogona*) were also noticed in sparse numbers. In no instance did I see any field of cane with the leaf mid-ribs mined by *Cosmopteryx* to the extent that it is usual to see in the Badila of the more Northern canefield.

Natural Enemies of Cane Pests.

I have not yet seen any digger wasps (*Campsomeris*), but have, in places, while following plough, picked up small cocoons attached to the remains of small grubs, These cocoons, which in every case were damaged when found, were probably those of a species of *Typhia.* Several times, whilst following plough, I have picked up larvæ of *Asilus illingworthi* and of a species of *Scenooinid* (*diptera*) similar, if not identical, to those which have been bred from Northern canefields. Both of these are predaceous larvæ, the former, which breeds into a robber fly, at least, being partial to grubs. I was told by Mr. Davidson, of Te Kowai, that amongst the grub-eating birds of the districts immediately about the river, the seagull took a very prominent position, as it comes in great numbers, is very quick, and has a great appetite. Crows and kookaburras are also of great use in this way.

Wallabies, Coots, &c.

Wallabies appear to have done considerable damage in the more outlying districts, but mostly in dry weather, some farmers having completely lost three to four acres of cane. It appears that these animals tackle the big cane as well as the small, sitting up and eating the heart or cabbage of the softer varieties. The stick then shoots up from the nodes and becomes useless for harvesting. The wallabies even go further at times and break the stick down altogether. Mr. Axam, manager at Farleigh, mentioned that an acquaintance of his had resorted to poisoning as a control measure. He would pull down a couple of leaf sheaths and thus expose the

softer and less-developed part of the cane, then drive the point of his knife into the cabbage and force some strychnine into the cut. This was done to odd sticks here and there. On the morning following his first attempt he found seven dead wallabies. Another farmer had tried dropping arsenic about the heart of the stick and thinks that he obtained success. Another pest which attacks the cane in a similar fashion is the coot, or water fowl, which does serious damage in lands adjoining swamps. Mr. Davidson, of Te Kowai, informed me, amongst other things, that last year, in the very dry weather, native companions and geese became troublesome. The former on one occasion destroyed two acres of cowpea and corn.

Lateness of Beetle Season.

In all these districts I have been constantly finding greyback beetles on their feeding trees. At Pleystowe I examined in one case four and in another six beetles shaken down. In the first instance two were females and in the second the females numbered five. At Racecourse I found a tree near Mr. Watson's farm which supported at least one hundred beetles. I examined twelve of these taken at random and found that nine of them were females. I had already examined a number, the big majority of which were females. All these females contained immature eggs from one-eighth to a-half developed in numbers varying from about two to eight. This examination was made on the 13th March. The Pleystowe ones were later.

MILKING RECORDS, COLLEGE DAIRY HERD, MARCH, 1924.

Name of Cow.	Breed.	Date of Calving.	Total Milk.	Test.	Butter.	Remarks.
			Lb.	%	Lb.	
College Cobalt ..	Jersey ..	14 Sept., 1923	780	4·7	42·90	
Iron Pl te ..	,,	3 Mar., 1924	728	4·9	42·00	
Dawn of Warragaburra	,,	10 Nov., 1923	660	4·9	38·10	
College Wildflower	,,	13 Aug., 1923	630	5·1	37·80	
Netherton Belle	Ayrshire	30 Oct., 1923	780	4·1	37·50	
College Sunrise..	Jersey ..	3 Jan., 1924	720	4·3	36·00	
College Grandeur	,,	11 July, 1923	510	5·9	35·40	
Magnet's Leda ..	,,	18 Aug., 1923	630	4·5	33·30	
Miss Fearless ..	Ayrshire	17 Nov., 1923	660	4·0	30·60	
Comedienne ..	Jersey ..	10 July, 1923	480	5·4	30·60	
Hedges Nattie ..	Friesian	21 Nov., 1923	690	3·7	29·70	
Bellona	Ayrshire	3 Aug., 1923	600	4·2	29·40	
College Promise	Jersey ..	14 Aug., 1923	540	4·6	29·10	
College Desire ..	Ayrshire	11 July, 1923	546	4·5	28·98	
Hedges Madge ..	Friesian	18 Aug., 1923	660	3·7	28·50	
Buttercup ..	Shorthorn	7 Sept., 1923	720	3·4	28·50	
Guid Lassie ..	Ayrshire	— Jan., 1924	630	3·8	28·20	
Songstress ..	,,	22 Aug., 1923	600	4·0	27·90	
Miss Betty ..	Jersey ..	30 Oct., 1923	570	4·1	27·30	
Dear Lassie ..	Ayrshire	1 Nov., 1923	540	4·3	27·00	
Fair Lassie ..	,,	28 Nov., 1923	540	4·3	27·00	
College Meadow Queen	Friesian	10 Jan., 1924	660	3·3	25·20	
Yarraview Snowdrop	Guernsey	7 Sept., 1923	420	5·0	24·60	
College Hope ..	Jersey ..	21 Oct., 1923	420	5·0	24·60	
College St. Margaret	,,	7 July, 1923	418	4·9	23·94	
Lady Meg ..	Ayrshire	14 July, 1923	540	3·5	21·90	
Gay Lassie ..	,,	5 July, 1923	460	3·9	21·24	
College St. Martha	Jersey ..	25 June, 1923	324	5·5	21·06	
Confidante ..	Ayrshire	7 Sept., 1923	510	3·5	20·70	
Miss Faithful ..	,,	— Jan., 1924	420	4·1	20·10	
College Queen Nan	Friesian	15 Feb., 1924	540	3·2	20·10	

BANANA WEEVIL BORER (*Cosmopilites sordidus*, Chev.)

SIXTH PROGRESS REPORT.

BY JOHN L. FROGGATT, B.Sc., Entomologist.

LETTER OF TRANSMITTAL.

3rd March, 1924.

This Bulletin (the Banana Weevil Borer, *Cosmopolites sordidus*, Cherv., Progress Report 6, by J. L. Froggatt, B.Sc.) embodies a wealth of exact detail concerning the insect to which it relates.

Whatever measures for its control have been devised have been conditioned—as is obvious they must be—by considerations of its habits and life history, in the elucidation of which the author's past work has been especially valuable and significant.

Whatever improvement be made with respect to these measures, as well as any additional ones that may be reached, must also be the outcome of such further facts as are herein brought to light.

These must therefore be regarded as of especial value and interest in solving the important problem affecting the Banana-growing Industry that the presence in Australia by the injurious insect alluded to truly constitutes.

HENRY TRYON, Government Entomologist.

As knowledge of the banana weevil borer becomes disseminated, and the devastation caused by this pest is realised, greater interest is being paid to this problem. As a consequence, information is being more eagerly sought for, resulting in a closer examination of the individual plantations. In this way we are finding that the area over which this beetle is already dispersed is considerably greater than was heretofore known. The assistance given by growers has been of great value, not only in adding to our knowledge of the distribution and habits of the pest, but also in testing in the field some of the more promising laboratory results in control measures. Co-operation has been forthcoming, however, from isolated individuals rather than from groups, and when the great number of banana-growers there are in the State, and the number that have even offered to assist are compared, the spirit of helpfulness is very slight indeed.

Many new plantations have been laid out, often without any inquiries being made regarding pests, with the result that beetle borer has later been found to be present, and in by far the greater number of cases the occurrence can be easily traced to its having been brought in with the original suckers. It cannot be denied that in certain instances this source does not readily explain the occurrence.

The longer the practical handling of the problem is allowed to lie in abeyance, the greater will be the difficulties besetting its control. Not only will the area of dispersion and the degree of infestation be greater, but also there will be so much more plant material that will have to be cleaned out, that even a single year's increase in this connection will be enormous.

Although the course of the investigations has, through unavoidable circumstances, been seriously interrupted, progress has been made and further valuable information obtained.

The Egg.

The time passed in the egg stage during January, 1923, averaged 4 days, and rose at the end of May to 27 days. Through June, July, and the early part of August very few eggs were obtained, and those separated from the corm were destroyed by fungus growths, which developed in the incisions made in the plant portions to which the eggs were transferred for observation. At the end of August the period was 21 to 22 days, and remained at 7 to 9 days from early in October through November, falling to 5 days in December (*vide* Table A).

The number of eggs deposited showed similar fluctuations throughout the year to those previously recorded, rising markedly in April and September, and falling very low in June and December (*vide* Table B).

The Larva.

A large number of larvæ were transferred to thin slices of corm, which were changed as required. The mortality amongst the newly emerged grubs on transference was very high, while a few of the partially developed ones were found dead in

the tunnels and covered in mould. It was not possible to ascertain whether this fungus growth was the cause of death or not, but it was thought to be rather a post-death development. Larvæ transferred immediately prior to, or after, moulting often failed to re-establish themselves in the fresh corm. At this time they have a quiescent period of several hours at least, and after moulting the sclerites of the head take some time to harden.

With eggs laid early in May, 1923, the larval period was greatly extended through the cold climatic conditions, occupying an average of 123 days, whereas with eggs laid in December, 1922, the period averaged 34 days. The longest period noted occurred with eggs laid 9-14/5/23, 130-133 days being passed in the larval state. The pre-pupal period has shown but slight variation through the year, occupying from 1 to 3 days.

It has been noted that with a larval period of 35 to 45 days there are at least three moults, one occurring about 8 days, another 18 days, and a third 24 days after emergence. With a larval period of 50-60 days a moult was noted about 32 days after emergence.

The Pupa.

The pupal period averaged about 8 days, but under conditions of lowered temperature it has lengthened to an average of 15 days.

The Life Cycle (*i.e.*, from deposition of egg to emergence of the beetle from the pupa) has naturally shown very wide variations at different periods of the year, ranging from 46 days (average) to 156 days (average). In the former case the eggs were laid early in December, 1922, and in the latter early in May, 1923 (*vide* Table C).

The longest life cycle period noted was with eggs laid 30/4/23 to 4/5/23, the imago emerging 10-11/10/23, a period of 159 to 165 days. Throughout the developmental periods of the beetle no data have so far been obtained on which a plan might be formed for destroying the insect while inside the plant. In the present state of our knowledge of this pest, the adult weevil is, therefore, the only stage over which control measures, other than cultural, can be exercised.

PLATE 66.—GRUB PUPA, AND ADULT OF BEETLE BORER.
(Natural size.)

The Imago.

Further records on the life of the weevil confirm that both in colonies and in solitary confinement, it lives for a very long time. From a consideration of all the laboratory data available on the longevity of the imago, the rate of mortality appears to be higher during March, April, and May than at any other period of the year (*vide* Table D).

A series of tests were made in order to study its powers of maintaining life without food. These have brought forward some extremely interesting information. For this work a fixed number of beetles were confined in tins 4 in. by 3 in. by 2 in. with soil. In each series a control lot was run with food; in a second tin the soil was dry, and in the third it was kept damp by adding a little water as required. In the dry soil the beetles died in about 6 days; this was fairly constant throughout all the tests made to date. In the damp soil, however, the last death occurred in from 70 to 121 days of the inception of the tests. The average life through several series was 97.5 days (*vide* Table E). The time of year appears to be an influencing factor, so further work will have to be done on these lines. The beetles for these tests were drawn from supplies collected in the field, their age being therefore unknown; it is possible that this may also be an influencing factor. The longevity without food has a large bearing on the question of replanting bananas on land from which the stools have been dug out. It is evident from these results that, provided every portion of banana plant is dug out and destroyed immediately, six months at least should be allowed to lapse before any replanting is undertaken. Since it is quite possible that under perfectly natural conditions the length of life may be longer than shown by the laboratory results, and also portions of plant material may be left behind on which the beetles could feed for a time, a full year should be allowed from digging out to replanting.

The effect of excessive moisture on the beetles without food was studied. In the earlier series the following procedure was adopted:—Five small jars were taken; in the first (a control) the beetles were placed in sifted soil with food; in the second the soil was damp; in the third the soil was thoroughly wetted; in the fourth the soil was waterlogged; in the fifth the beetles were submerged in water without any soil. The weevils were exposed under these conditions for varying periods of time, and were then transferred on to a banana corm over dry earth. The effect on their life noted in these tests was very slight over periods up to 2½ days.

In later series, only the submergence in water was tested, and in this connection it would appear that the time of year is again an influencing factor. Over short periods of submergence (*i.e.*, up to 2 days) mortality is not very high, but from 6 to 10 days, although the beetles are for the major part alive when transferred, they die within a short time afterwards in the spring. In July, 52.5 per cent. were killed as a result of submergence of from 120¼ hours to 288¾ hours (5 to 12 days approximately), while in August 100 per cent. were killed in periods from 147½ hours to 264 hours (7-11 days approximately). A submergence of 48 hours in September only caused the death of 40 per cent., whereas from 62 to 135 hours' submergence resulted in a mortality of 93.3 per cent. (*vide* Table F).

Suckers used for planting have been found at times to contain living beetles. It has been stated that soaking corms in water for a number of hours would kill this pest. From the results just quoted this is evidently a fallacy, especially when it is considered that the conditions of the tests were the most rigorous it was possible to obtain. Both these lines of research emphasise the extreme tenacity with which these beetles cling to life.

Action of Poisons on the Beetles.

During the last active period, further work was done on the effect of poisons on the imago. Attention was concentrated on the two chemicals—sodium arsenite and "Paris green" (copper aceto-arsenate). Arsenic trioxide was also used; the action of the latter appears to be much slower than that of the two former ones, but further work requires to be done with it. "Paris green" still appears to

be the most satisfactory poison used to date, having a stronger action than any of the others, resulting in the death of the greatest number in a shorter time. The procedure was the same as that given in my third report (*vide* "Queensland Agricultural Journal," 22nd October, 1923, page 289.) The pieces of corm were shaken up in the mixture for from five to twenty minutes and placed in separate tins with sifted soil. An equal number of beetles were then placed in each tin and left with the poisoned material for varying periods of time; at the termination of each of which fresh (untreated) corm was substituted for the treated portions. Observations were made from day to day to ascertain the number alive. This work was carried out in tins 4 inches by 3 inches by 2 inches. The diluent used with the powder poisons was in every case wheaten flour.

The following chemicals have been used to date:—

Sodium arsenite, both in solution and as a dry powder; mercuric chloride (corrosive sublimate) in solution; barium chloride in solution; Paris green as a dry powder; calcium arsenate as a dry powder; lead arsenate as a dry powder; borax (sodium tetraborate) as a dry powder; copper resinate as a dry powder; copper sulphate (bluestone) as a dry powder; arsenic trioxide (commercial) as a dry powder; barium sulphate as a dry powder; sodium acetate as a concentrated solution.

A summary of the laboratory results to date may be of interest. As has been previously stated ("Queensland Agricultural Journal," June, 1923, page 524), the chemicals in solution have been found to be unsatisfactory, the best results having been obtained with those used as dry powders.

Poison.	How Used—A Powder or in Solution.	Dilution.	Period of Year.	Exposure to Poison, in Hours.	Per Cent. Killed.	Control Per Cent. Alive.
		Per Cent.		Hours.		
Barium Chloride ..	In Solution ..	5	November	18–48	2	100
	ditto ..	2	ditto ..	18–48	6	100
	ditto ..	1	ditto ..	18–48	1	100
Mercuric Chloride ..	ditto ..	0·1	ditto ..	18–48	2·5	100
	ditto ..	·06	ditto ..	18–48	2·5	100
	ditto ..	·05	ditto ..	18–48	2	100
Sodium Arsenite ..	ditto ..	2	October ..	18–48	10·5	100
	ditto ..	1	ditto ..	18–48	1·5	100
	ditto ..	·5	ditto ..	18–48	2	100
	Powder ..	1·3	June ..	18–54	92·5	100
	ditto ..	1·3	September	18–42	100	100
	ditto ..	1·6	ditto ..	18–42	98	100
	ditto ..	1·3	ditto ..	3–24	74·4	100
	ditto ..	1·6	ditto ..	3–24	69·4	90
Arsenic Trioxide ..	ditto ..	1·3	October ..	18–72	88·1	90
Borax	ditto ..	1·3	June ..	18–60	80	100
	ditto ..	Pure ..	July ..	18–58	85	90
	ditto ..	ditto	September	18–66	94·4	100
	ditto ..	ditto	November	3–24	43·8	90
Calcium Arsenate ..	ditto ..	ditto	April ..	18–48	71·3	100
	ditto ..	1·6	ditto ..	19–48	63·1	100
Lead Arsenate ..	ditto ..	1·6	May ..	19–92	20	100
Paris Green	ditto ..	Pure ..	February ..	18–48	99·4	80
	ditto ..	1·6	March ..	18–48	96·9	100
	ditto ..	1·6	ditto ..	3–24	97·5	80
	ditto ..	1·6	April ..	½–3	56·9	90
	Suspension in weak flour paste	..	February ..	18–48	80·6	100
Barium Sulphate ..	Dry Powder ..	1·6	January ..	18–48	14·4	100
Copper Resinate ..	ditto ..	2·3	April ..	18–48	2·5	100
Copper Sulphate ..	ditto ..	2·3	May ..	18–48	2·5	100
Sodium Acetate ..	In Solution ..	Concentrated	December ..	18–66	27·8	100

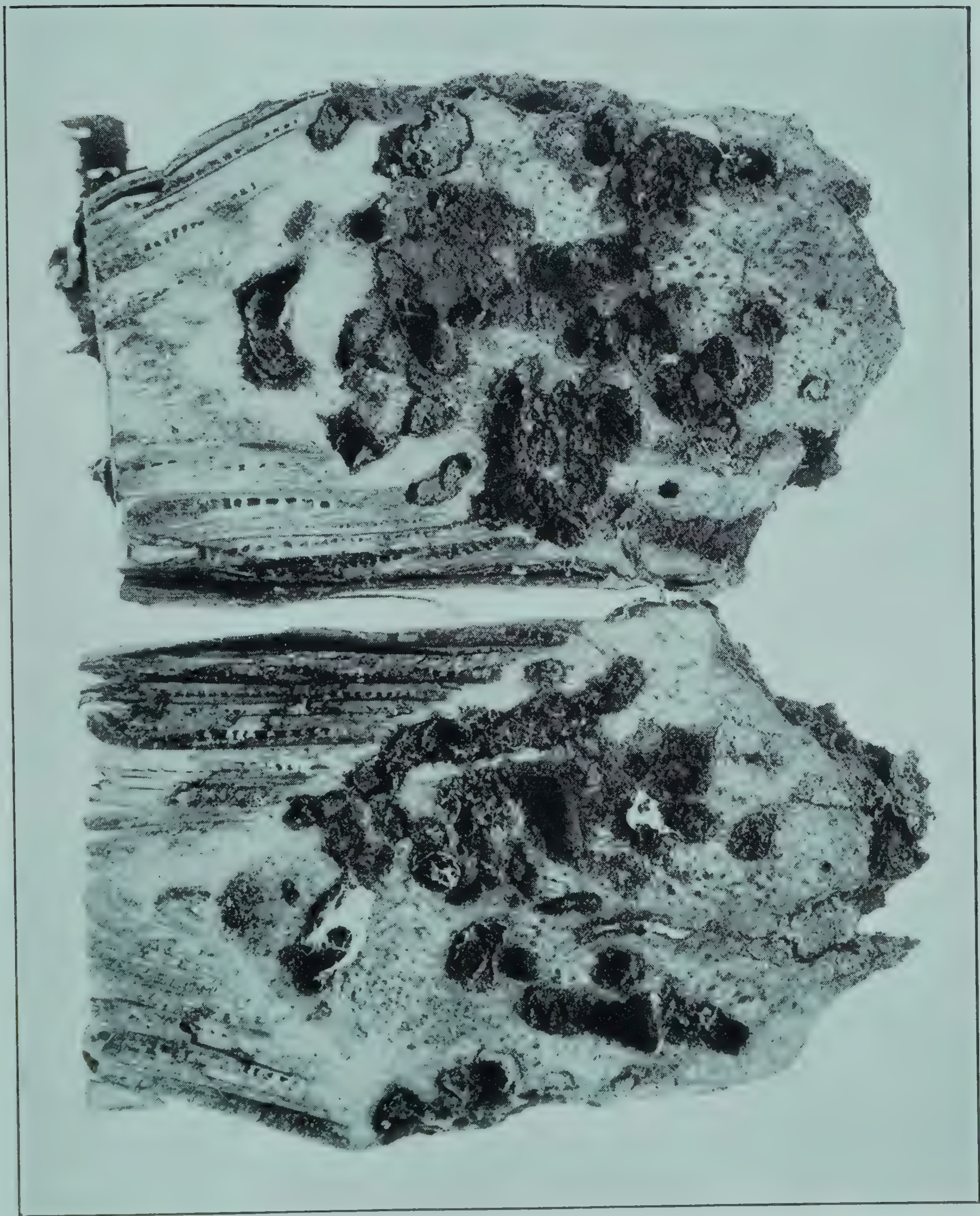

PLATE 67.—BANANA SUCKER, ABOUT THREE MONTHS OLD, SHOWING SEVERE INFESTATION BY THE BORER.

It is seen from these figures that the most promising results to date were obtained with Paris green and sodium arsenite, followed by arsenic trioxide and borax. Calcium arsenate gave fair results, and further work will be done in testing it in other series during more active periods.

The simple copper and barium salts have been decidedly disappointing.

The course of this work, particularly, was seriously checked last year by a variety of unavoidable circumstances. Since it has been found that the rate of mortality under similar conditions is less in the inactive than in the active periods, this experimental work has had to be confined to those times when the maximum effect might be expected, thus prolonging the time taken for this investigation far beyond what was anticipated. The results to date show, however, that we have one poison at any rate that will cause a high rate of mortality when the beetles are exposed to it for only a short period of time. It may be stated that this one, Paris green, has been used in the field with very promising results. Further research may show that a still more satisfactory poison, or mixture, may be obtained.

In reference to the flight of the adult insect, there are no laboratory data of a positive nature on which to base any opinoins. Information has been received, however, from several correspondents showing that flight does occur under certain conditions, the nature of which are unknown. This data may be thus summarised.

In one case beetles were found in a vessel just inside, and in another in a tub just outside, the house. The distance from banana stools to where the imagos were found was from 10 to 30 yards. The first observation was made early in December, and the second early in February. No specimens were submitted for identification, and data on climatic conditions were incomplete.

In another case the beetles flew into the room through a large open shutter, a little after 7 p.m. on a warm, cloudy night early in February. In one other instance the beetles flew at night at a height of about 12 feet on to a table on the veranda of a house situated close to banana stools. The climatic conditions were given as ''muggy after a day's solid rain.'' This occurred during the first week in March. In both the two latter instances the beetles were collected and sent in for identification.

Owing to the normal abhorrence of light shown by the beetles, this is a very difficult matter to follow up. Our knowledge of the factors governing flight is at present nil, and until fuller and more definite information is obtained on this matter it is not possible to state to what extent the flight of the beetles will influence the present practice of control.

It would appear from the observations to date that the powers of flight are not greatly exercised. It may be found that flight only occurs for a very short period of the year, and for short distances. Wind is certain to exercise a great influence over the distance they may travel.

From the above observations on this mode of progression, it will be observed that every record of flight so far falls within the inactive periods of the beetle existence, or at a time when the females would not be burdened with the task of actively developing eggs. There is also the possibility that they may be ones that are recently matured and unmated.

There now can be no doubt but that the beetles do fly under certain undetermined conditions during the summer months, such flight occurring at night. It must be regarded as a potential menace, particularly where old abandoned or badly neglected plantations exist where the beetle is breeding unhindered in large numbers, and must, sooner or later, look further afield for fresh food and breeding grounds. These need to be completely destroyed and measures undertaken to destroy the beetles present.

Control.

It has been stated that the flight of beetles would render present methods of control more or less useless. This cannot be allowed to pass without comment. It refers either (1) to the advised necessity of obtaining suckers free from the pest for planting; or (2) to the question of cleaning up plantations.

In reference to (1) the question may be asked—Is it better to start with a plantation free from the pest and run the possible risk of having odd beetles fly in at some indeterminate period to make slow headway for a time, or to obtain suckers from any plantation which is more than likely infested with the borer, with the result that most certainly some, if not many, of the plants will be put in the ground with the pest already in them? All thinking men will surely agree that the former is the preferabe way to set out. If cultural methods are practised from the time the plantation is begun, a careful watch will show early signs of any infestation should

such occur, and the labour of control measures should not then be very great. But to knowingly plant borer with the suckers, which is constantly being done, means an early termination to the productivity of the plantation and a poor return for the labour and outlay.

In reference to (2), if the beetle is already in a plantation and cultural methods have been conscientiously carried out, the pest will be prevented from increasing in numbers to a very large extent, and in this way the devastation caused is minimised very greatly. For this reason alone such work can never be wasted.

The means of cleaning up a plantation and the reasons for it have been dealt with in previous reports, hence there is no need to recapitulate them here. Directions for the use of poisons on baits may prove of interest to some. It must, however, be first emphasised that poison baits alone are *not* sufficient to kill out the beetles in any area. They only minimise very considerably the labour and time spent in going round and examining the ordinary unpoisoned corm, and collecting and destroying the beetles found under them.

Thoroughly mix one part of Paris green with six parts of flour; this is best done by shaking the two together in a large tin. From this transfer what is required into a smaller tin with a finely perforated lid, which can be carried round. Dust the powder over the freshly cut baits, composed either of pieces of corm or split stem, and lay them face down on the bare ground wherever infestation has been observed; the best site at stools is inside or just outside. If there is any trash about, it is advisable to cover the bait over with a little of it; this prevents the bait drying too rapidly, and also makes the immediate vicinity darker, which is what the beetle prefers. These baits should be examined from time to time and renewed as required. Dusting the poison mixture over the stumps of plants when such are freshly cut off close to ground level is also of great assistance in this connection. Both this and the covering over of the baits have been proved to be advantageous by the grower who was giving the mixture a field trial.

It must be constantly borne in mind, in considering the question of control, that—

(1) The grub not only damages the plants, but passes the whole of its life inside them; for this reason it cannot be reached by any ordinary method of treatment for insect pests.

(2) The beetle lays the eggs, from which comes the grub. In the adult stage this weevil lives outside the plant, and is therefore vulnerable.

(3) By destroying breeding grounds and harbourage as far as possible, the pest cannot increase in numbers at such a rapid rate as would otherwise occur, and for lack of outside shelter is driven into the stools, where it can be treated more readily than when it is broadcasted through the plantation.

If any grower should be in doubt at any time about the borer, he has only to write in to the Department of Agriculture, Brisbane, and all information available, and any advice possible, will be willingly supplied.

TABLE A.

Eggs Laid.	Days to First Sign of Mandibles.	Days thence to First Emergence.	Days for Total Emergence.
30/12/22 to 6/1/23	..	..	4 to 5·5
5/4/23 to 30/4/23	9	2	11 to 13·5
30/4/23 to 24/5/23	12·5	2·5	14·5 to 19
24/8/23 to 28/9/23	14	2	14·6 to 18·4
28/9/23 to 29/10/23	7	1	8·7 to 10·4
29/10/23 to 29/11/23	6	1·5	7·2 to 8·2
29/11/23 to 18/12/23	5	1	5·8 to 7

TABLE B.

1923.	Lot.																	
	X.	Y.	Z.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Monthly Totals.
January.. ..	23	46	31	18	26	47	46	2	..	..	..	..	..	..	..	..	..	239
February ..	8	5	8	2	8	10	4	0	..	..	..	..	..	..	..	..	..	45
March	17	10	13	8	12	35	4	9	..	..	..	..	..	..	..	..	..	108
April	42	16	68	16	31	188	75	1	38	..	..	..	..	..	..	..	..	475
May	26	13	61	6	7	218	105	..	180	..	From 7/9/23.	From 27/9/23.	..	..	..	..	..	616
June	2	4	33	1	2	75	56	..	58	..			..	..	..	..	..	231
July	..	..	2	1	0	19	5	..	24	..			..	..	..	..	..	51
August	..	..	1	..	..	6	2	..	15	17			..	..	..	..	..	41
September ..	..	..	2	..	..	99	21	..	170	149	60	24	..	..	..	..	..	525
October ..	..	..	..	..	..	17	0	..	372	229	245	268	35	..	..	..	..	1,166
November ..	..	..	..	..	..	..	..	..	126	141	86	101	18	123	127	9	..	731
December ..	..	..	..	..	..	..	..	..	11	30	16	52	5	36	27	116	3	296
Total—Year ..	118	94	219	52	86	714	318	12	994	566	407	445	58	159	154	125	3	4,524
Eggs laid to 30/12/22 ..	711	881	699	309	260	210	210	0	..	..	..	..	..	..	..	..	..	..
Totals for each lot	829	972	918	361	346	924	528	12	994	566	407	445	58	159	154	125	3	..

TABLE C.

Eggs Laid.	Egg Period in Days.	Larval Period in Days.	Pre-pupal Period in Days.	Pupal Period in Days.	Life Cycle in Days.
20–24/11/22	5– 8	41– 45	..	6– 8	54– 59
4–15/12/22	5– 8	30– 38	..	4–10	44– 50
30/14/23—14/5/23 ..	15–19	118–128	...	10–21	154–159
3–18/9/23	15–20	40– 44	2–4	7– 8	63– 71
5–26/10/23	8– 9	34– 40	1–2	7–10	50– 54
29/10/23—13/11/23	5– 8	32– 43	1–3	5– 8	51– 57

TABLE D.

Collected or Bred.	Reference to Series Lot.	Date of Collection or Breeding.	Date of Last Death.	Life in Days.	In Terms of Lunar Months.						
					Months.	Weeks.	Days.		Months.	Weeks.	Days.
Collected ..	X	20–21/7/22	1–14/8/23	376—391	13	1	2	—	13	3	6
Ditto ..	Y	1–12/8/22	24/8/23 to 3/9/23	377—391	13	1	3	—	13	3	6
Ditto ..	Z	1–16/9/22	21–28/9/23	370—392	13	0	6	—	14	0	0
Ditto ..	1	13/10/22	10–17/7/23	270—277	9	2	4	—	9	3	4
Ditto ..	2	18/10/22	1–14/8/23	287—301	10	1	0	—	10	3	0
Ditto ..	3	7–8/11/22	22–26/10/23	348—353	12	1	5	—	12	2	3
Ditto ..	4	27–30/11/22	2–5/10/23	306—313	10	3	5	—	11	0	5
Ditto ..	5	1–4/12/22	9–13/4/23	126—133	4	2	0	—	4	3	0
Ditto ..	6	13–18/4/23	22–28/1/24	259—270	9	1	0	—	9	2	4
Ditto ..	7	25–26/7/23	1–11/2/24	190—201	6	3	1	—	7	0	5
Ditto ..	Single	23/2/22	9–12/3/23	379—382	13	2	1	—	13	2	4
Bred ..	38	11–12/12/22	3–7/12/23	356—361	12	2	6	—	12	3	6
Ditto ..	50	11/12/22	16–19/10/23	309—313	11	0	1	—	11	0	5
Ditto ..	68	14–15/12/22	30/8/23 to 3/9/23	268—273	9	2	2	—	9	3	0
Ditto ..	97	17–18/12/22	2–5/10/23	288—292	10	1	1	—	10	1	5

TABLE E.

Series.	Date Started.	Longevity.	
		In Dry Soil.	In Moist Soil.
		Days.	Days.
1	10/4/23	4– 6	107
2	22/5/23	5– 6	121
3	24/8/23	6– 7	85
5	4/10/23	4– 6	70
6	18/10/23	9–10	98
7	15/11/23	8– 9	102

TABLE F.

Series.	Date Started.	Per cent. Alive on	In Control.	No. 1.	No. 2.	No. 3.	No. 4.
2	19/9/22	30/9/22	90	70%	80%	100%	90%
	Period of	submergence	..	96 hrs.	96 hrs.	96 hrs.	96 hrs.
3	16/6/23	12/7/23	100	90%	90%	90%	100%
	Period of	submergence	..	48 hrs.	72 hrs.	96 hrs.	120 hrs.
4	12/7/23	16/8/23	50	50%	40%	70%	30%
	Period of	submergence	..	120 hrs.	194 hrs.	265 hrs.	289 hrs.
5	27-8-23	14/9/23	70	0%	0%	0%	0%
	Period of	submergence	..	147 hrs.	216 hrs.	240 hrs.	264 hrs.
6	12/9/23	28/9/23	50	60%	10%	0%	10%
	Period of	submergence	..	48 hrs.	62 hrs.	110 hrs.	135 hrs.

RATOON COTTON.

"In the early stages of the controversy on the Ratoon Cotton Question, a promise was made," said the Acting Minister for Agriculture and Stock (Hon. W. Forgan Smith) in the course of a recent Press statement, "that a test would be carried out on the English markets to secure an impartial report upon ratoon cotton from the English market point of view." "On the 9th November, 1923," continued the Minister, "the s.s. 'Leitrim' carried from Brisbane thirteen bales of cotton consigned to the Agent-General for Queensland in order to comply with the promise made to the advocates of the practice of ratooning. These thirteen bales were made up as follows:—(*a*) Ten bales of Upland ratoon lint; (*b*) two bales of Durango ratoon lint; (*c*) one bale of Annual Durango. As the promise made was to secure an impartial report on ratoon cotton, this consignment was put in the hands of Messrs. A. J. Bustom and Co., a private firm of cotton brokers at Liverpool, which firm is in no way connected with the British Australian Cotton Association, the Empire Cotton Growing Corporation, or the British Cotton Growing Corporation, and the report from this firm upon this consignment is therefore an unbiassed one, and is interesting, as it shows distinctly that the ten bales of Upland ratoon lint were valued at ¼d. to 1½d. per lb. less than the middling American cotton, which is the standard grade accepted all over the world."

As regards the two bales of Durango ratoon, which realised ¾d. to 1¼d. above middling American, the Minister pointed out that this lint was from properly ratooned pure Durango plants, and it was to be expected that the valuation would be at a higher price than the ordinary ratoon.

The bale of Annual Durango which was sent with the consignment was valued at 2d. above the value of middling American, and this valuation shows a marked difference in the values placed on annual and ratoon cotton on the English market.

"The Sydney market and the Japanese market were also tested some time ago," continued Mr. Forgan Smith, "with the same results in favour of annual cotton."

The results of all these shipments emphasise the desirability of keeping up the quality of Australian cotton to the highest pitch, because it will be realised that it is only by so doing that we can hope to make cotton-growing a permanent industry in this State.

BREEDS OF PIGS.

E. J. SHELTON, H.D.A., Instructor in Pig Raising.

THE DUROC-JERSEY—A RECENTLY INTRODUCED AMERICAN TYPE.

There are several breeds of pigs in the United States of America which have been developed under purely local conditions, yet which have proved themselves as of considerable value in the uplift of that greatest of all American ventures, the hog industry. The Poland-China (of which we in Queensland know something, as the type was introduced many years ago), which originated in the States of Ohio and Illinois; the Duroc-Jersey, which came into its own in New Jersey and in New York; the Chester White, whose native home is claimed to be the State of Pennsylvania; the Victoria, a breed developed in New York and Indiana; the Cheshire, also originating in New York State; the Hampshire, or the belted breed; and the Mule Foot, whose originators claim as being immune from swine fever (in America always referred to as hog cholera).

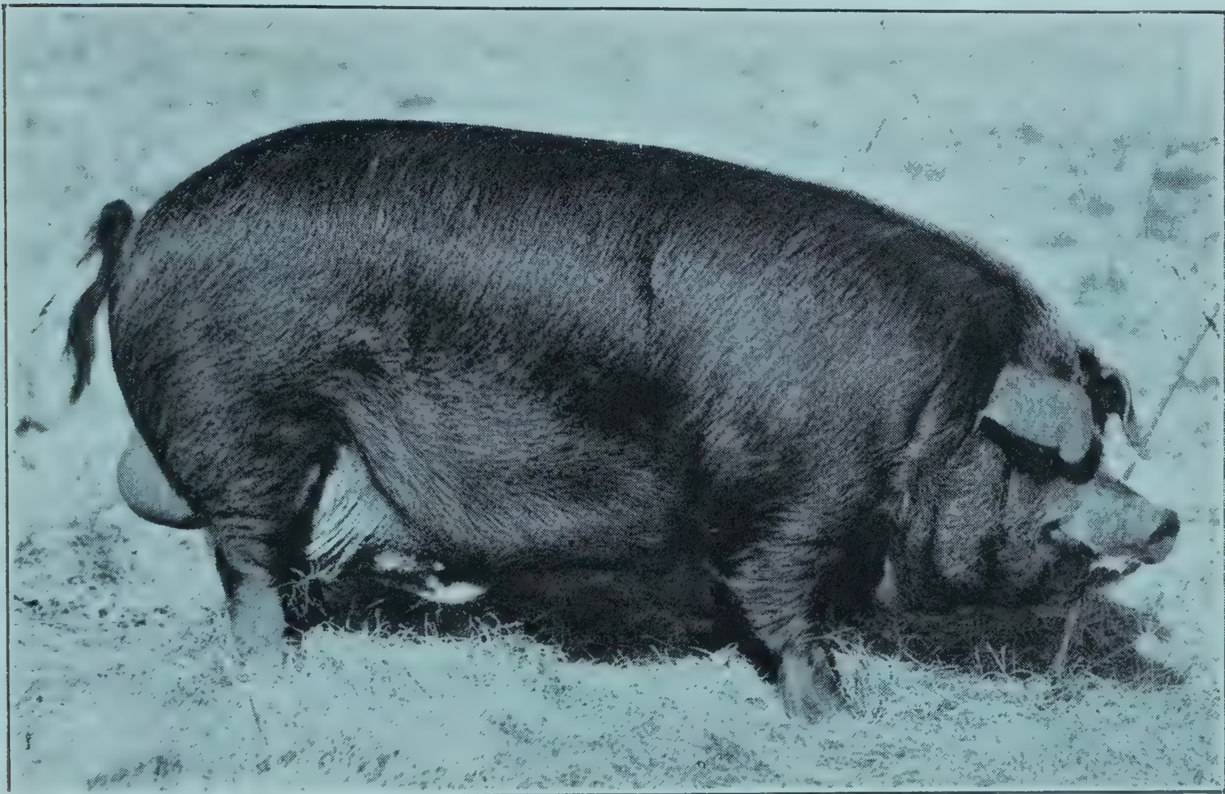

PLATE 68.—DUROC-JERSEY BOAR.
A Prominent Prize-winner at American State Fairs.

The Duroc-Jersey.

It was during the autumn months of 1922 that the Duroc-Jersey breed of pig was first introduced into Australia, the importation comprising one boar and two young sows from Canada to the order of Mr. Fred. G. Brown, of Moorabin, Toogoolawah, a Queensland enthusiast who had a few months prior to that date toured Canada, and was so impressed with the breed that he had made several purchases. The pigs were but ten weeks old when they arrived here, and were somewhat out of condition as a result of the long ocean voyage, hence did not attract the attention they would have done under other and possibly more favourable circumstances; but after a few weeks' careful handling and feeding in their new home they began to put on flesh, and were so well advanced that at the age of five months they were exhibited for the first time in Australia at the Brisbane Show.

It was estimated by the writer at that time (five months old) they would weigh 120-130 lb. dressed weight, and many competent pig buyers discussed their merits, and it was generally agreed they represented a very superior type of animal; a pig which should do remarkably well under Australian conditions, where we aim at quick growth and early maturity, and where these special qualifications count much in their

favour, and where the red pig (for they are cherry red in colour) has advanced in popularity and is, particularly in Queensland and New South Wales, in good demand.

Since that date both sows have proved to be excellent breeders, rearing good litters of pigs of even better type than the parents. As an illustration, one of the suckers, when five weeks, weighed 38 lb., and developed so rapidly that when four days under three months old he and several of his litter mates weighed from 73 lb. each, in the case of the picked pigs, down to 65 lb. in the case of one or two smaller sows, these figures having been certified to by Mr. Brown at the time the pigs were weighed. These are remarkable weights in comparison with our general average here, and should go a long way towards popularising the type.

The Origin of the Duroc-Jersey.

The Duroc-Jersey is of American origin, though at present, owing to export regulations, the importation of pigs from the United States of America is practically prohibited, hence our supplies come from Canada, where the type is also largely bred, and where the regulations governing export overseas are less stringent.

To show the extent to which the breed has been distributed, it is officially stated by the Duroc-Jersey Swine Breeders' Association of the United States of America that more than 40 per cent. of the pedigreed pigs in the United States of America

PLATE 69.—A GRAND CHAMPION DUROC-JERSEY SOW AT AMERICAN STATE FAIRS.

to-day are of this breed. The type appears to have been developed from a strain of pig introduced into America from Spain as far back as the year 1820. These were red or sandy-coloured hogs that had the reputation of growing to an enormous size with a good quality flesh. Doubtless, during the days of American slavery, when ships traded with different countries carrying slaves and food supplies, &c., some of the more interested chiefs carried with them as "booty" some of these red hogs, for we have authentic record of their having been introduced both from Guinea and New Jersey, as well as from Spain. It is presumed that they were introduced by or for breeders who had a fancy for a red hog, for hogs of that colour were well known "way down in Tennessee" and in Saratoga, New York, and were considered to be far superior to the types common in most States, though they were smaller and apparently less profitable than the Spanish type appeared to be. It is possible, too, that descendants of the old English Berkshire, which were introduced later to improve and develop the Poland-China, may have reverted to a reddish-coloured hog, for these old English types were all inclined that way many years ago, and even at the present time we find the Berkshire has this tendency when their breeding is neglected, though we look upon this as a sign of degeneracy more than as a result of neglect. Historical records further prove that the Berkshires of olden times were of a reddish hue (there is a "Red" Berkshire breed in America to-day). So it was that between the several types fanciers of the red pig made their choice, and by continued effort in the

direction named they eventually produced a permanently red pig of great value. The Spanish type had during this period commonly been known as the Jersey Reds, and those found so numerously in Saratoga were styled the Durocs. The blending of the two types proved so profitable that it was eventually agreed to combine the two names, using the American type as the standard, hence they have from that date been known under the title of the Duroc-Jersey. Other names by which the breed had previously been known were the Jerseys, the Red Rocks, the Clay Rocks, the Dew Rocks, the Red Graziers, the Red Berkshires, and the Red Guineas.

It was in 1883 that the American Duroc-Jersey Swine Breeders' Association was formed in Chicago, and the name was then formally adopted. As we now have them they are not unlike the Berkshire or Poland-China, except in colour, and they make up into excellent quality pork or medium weight bacon pigs at a very early age and on a comparatively small amount of food.

The ideal colour that breeders aim at is a cherry red, though both bright red and dark cherry are allowed. It would appear that as yet the colour is not permanently fixed—even the Tamworth pigs vary a good deal in colour, and they are one of the oldest breeds known. The colouration of animals is in itself a very interesting study.

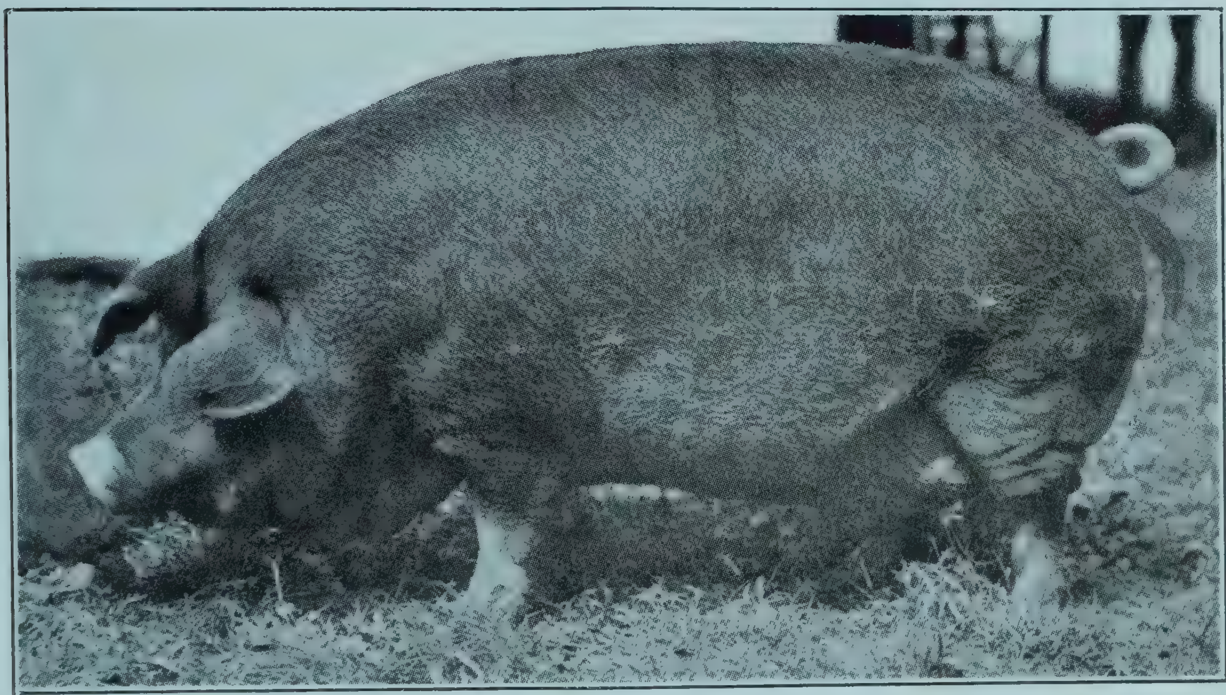

PLATE 70.—AN AGED DUROC-JERSEY SOW.
A well-known American Prize-winner.

The Type.

In America and Canada the Duroc-Jerseys are classed as "lard hogs"; that is, they belong to a type of pig that fattens rapidly and develops into a medium sized fat pig. In disposition they are very docile and contented, in itself a very valuable feature in any breed; they are active and vigorous, good paddock pigs, though they may not stand extreme heat, whilst they are equally prolific, if not more so, than Poland-Chinas, in general, producing litters of from eight up to fourteen. In this respect it is doubtful if any of the other American breeds can surpass them.

For Australian conditions they should be an extremely useful type, where bacon-curers and pork butchers have a decided fancy for red or spotted red and black pigs.

Further importations of the breed will doubtless be arranged for later on. A quartette of young sows and an unrelated boar arrived quite recently to supplement the first shipment; but, of course, it yet remains to be seen whether they will become as popular as our other and more firmly established types.

FRUIT FLY INVESTIGATION.

ENTOMOLOGIST'S REPORT.

The Minister for Agriculture and Stock (Hon. W. N. Gillies) has made available the following report, dated 29th April, of the Entomologist at Stanthorpe, Mr. Hubert Jarvis, in relation to the Fruit Fly and certain other insects either harmful or useful:—

FRUIT FLY.

1. *Fruit Fly.*—During the months of February and March, 1924, the Fruit Fly, *Chætodacus tryoni*, was prevalent throughout the Granite Belt District, all the latest ripening fruits being badly attacked.

Many orchardists reported "the Fly" visiting their orchards in a swarm, and attacking all available fruit. This would seem to indicate either an enormous natural increase of "Fly" within the district or a visitation from infested areas outside the Granite Belt, or perhaps derivation from both of these sources.

There was, it may be added, a noticeable lack of interest in "Orchard Hygiene" (*i.e.*, the gathering and destruction of all "fly-stung" fruit) during the latter end of the season.

Poison-bait sprays or repellants were apparently useless in preventing Fruit Fly attack during February, and more particularly in March. Female Fruit Flies, trapped and examined during both these months, were in nearly every case fully matured and ready to deposit eggs.

The fruits principally attacked during February were late peaches, pears, apples, and quinces. In March, however, it was discovered that the Fruit Fly was ovipositing in several other fruits—both wild and cultivated ones. About 12th March Fruit Fly maggots were discovered in grapes in the Stanthorpe district. On 25th March all doubt, if any then existed, as regards the Fruit Fly (*C. tryoni*) attacking this fruit vanished. The fly was watched at work among grapes, and many larvæ, both small and large, were found within the fruit; and, moreover, 180 Fruit Flies were caught in two traps that had been set for seven days among the vines.

Fortunately, however, only a small percentage of Fruit Fly maggots seem to reach maturity in grapes, owing principally to the juice of these rapidly fermenting, a condition being thus brought about which quickly proves fatal to them. Not so, however, to the little fermentation fly, *Drosophila*. This latter fly is only about ⅛ inch in length, and literally swarms around punctured or cracked fruit, in which it deposits its eggs. The numerous resulting maggots undoubtedly help to bring about that fermentation so fatal to the Fruit Fly maggots proper; in fact, the little *Drosophilid* larvæ seem to thrive when living under this circumstance.

Further, on 13th March, Fruit Fly maggots were found at Ballandean, in, too, the fruit of the common naturalised blackberry (*Rubus fructicosus*); and, on a search being made in blackberries in other localities within the district, additional Fruit Fly maggots were discovered in them also. [*Note.*—A number of the maggots from this source were placed in the insectary in jars, and ten Fruit Flies have to date emerged. All these flies proved to be the notorious fruit-pest *Chætodacus tryoni.*]

On 31st March, still additional associations were brought to light, Fruit Fly maggots being then found in tomatoes and also in Cape gooseberries (*Physalis*) in cultivation.

2. *New Fruit Fly.**—This large and handsome Fruit Fly was first captured by me at the Summit in February, 1921; in 1922 it was also observed during both February and March on cultivated fruits; but efforts to rear examples of the species from fruit maggots proved unavailing until this season. Both sexes of the insect have now been bred in the insectary from pear, and quince also.

* The discovery of this Fruit Fly has been referred to by us in the Brisbane daily Press, under the designation "Jarvis' Fruit Fly."—H.T.

This fly appears to be distributed throughout the district, since specimens are to hand from Applethorpe, The Summit, Thulimba, Dalveen, and Glen Aplin. All specimens obtained at large were female flies and were caught in traps; four males as well as many females have, however, now been bred from maggots in fruit, and thus in viewing both sexes, that this fly is a species distinct from *Chætodacus tryoni* is quite evident. In the field it is strikingly different from this latter species, being entirely golden yellow in colour, with very bright, iridescent-green or golden-green eyes. It is thus easily recognised when on the fruit, and was noticed by many orchardists this season.

Although a late comer this Fruit Fly, apparently, does not hibernate (over-winter) here, as it never makes its appearance until towards the end of February, and it is only reasonable to suppose that, in the event of its overwintering as a pupa, it would make its appearance in the spring or early summer. This, however, as I have stated, is not the case.

3. *Destruction of Maggot-infested Fruit.*—Although boiling is recognised as a safe and effective way of destroying the eggs and maggots of the Fruit Fly in infested fruit, I am of opinion that drowning, if properly carried out, is equally effective and safe, and can be resorted to whenever and wherever circumstances admit of its use. An old tank or large barrel will answer the purpose very well; it should be about half filled with water, and the fruit first emptied into it as collected. This fruit—generally a mixture of all sorts and varieties—quickly starts to ferment, thus destroying all Fruit Fly maggots and eggs. Any fruit floating on the surface can be easily kept under water by placing an old sheet of galvanised iron on top of it, and then placing a stone on top of the iron. If desired, a small cupful of kerosene can be poured on the surface of the water; this will kill any grubs or maggots that come in contact with it. Provided that an old tank, or even barrel, be available, the above is a quick and cheap way of dealing with maggot-infested fruit. The fruit can be left in the barrel for weeks or all the season if desired; and the longer it has been soaking the more effective will be the liquid in destroying Fruit Fly maggots.

4. *Field Experiments.*—In order to ascertain if the Fruit Fly overwinter as a pupa in the Granite Belt area, numerous wire-gauze cages containing maggot-infested fruit have been placed out—at Dalveen, The Summit, Applethorpe, and Stanthorpe—and additional ones will also be placed out during May at other places in the district.

Fruit Flies are being kept alive in large cages, under almost natural conditions, in the insectary. The first of these flies hatched on 1st April; daily additional hatchings have brought the total up to forty-five. These cages are standing in soil and there is ample room within them for the flies to move their wings freely and to visit fruit suspended from the roof of each, for possible ovipositing and other roof purposes.

WOOLLY APHIS OF APPLE.

Woolly Aphis Parasite (*Aphelinus mali*).—On the 18th March, acting on instructions from the Chief Entomologist, Mr. H. Tryon, Mr. A. A. Girault (Assistant Entomologist—a recognised authority on Chalcididæ) was met at Stanthorpe and conducted to the orchard where over fifty Woolly Aphis parasites had been liberated. Within the first half-hour one parasite was seen crawling on the under surface of a leaf, and it was not long before a specimen was also secured; this proved to be the Woolly Aphis parasite (*Aphelinus mali*). Two other specimens were caught on apple trees situated some distance away from the tree on which the insects were first liberated. Thus it is reasonable to conclude that this useful Chalcid wasp is established in at least one orchard.

Further supplies of *Aphelinus mali* have, moreover, been promised by Dr. R. J. Tillyard, M.A., &c., and should arrive here during the winter. Given thus more favourable weather conditions than those obtaining through August and September, 1923, when the previous consignment was received, it is hoped to establish this insect in further additional orchards next season. Owing to the short life of the adult parasite ("a small wasp"), it is impracticable to transmit it in a living state during the summer. The parasite passes the winter months as a pupa, or chrysalis, within the old shell of the aphid that it has destroyed, and in this stage of its existence it can, on the other hand, be readily sent long distances with safety.

OTHER INJURIOUS INSECTS.

1. *Codling Moth.*—Much damage has been caused by the Codling Moth in the Stanthorpe district during February and March, and it is estimated by most growers that their losses this season were due rather to Codling Moth than Fruit Fly. Throughout the month of March, Codling Moth larvæ or caterpillars were found in fruit. These larvæ were of all ages, from quite small grubs to the full-grown stage insects.

The cleaning up of packing sheds throughout the district is of the utmost importance in fighting this pest. Packing benches should be taken to pieces and carefully examined for larvæ, and if possible an easily movable type of bench installed in their places.

A hasty spraying with merely hot water, or soda solution, is not effective in destroying Codling Moth larvæ; boiling water or water as near the boiling point as possible, if poured into all cracks and crevices, will kill all sheltering larvæ therein. Codling Moth grubs have been found to be alive and active several days after crawling over, and being stationary on, wood thoroughly wet with a strong caustic soda solution; the close silk-envelope around the resting larva protects it from any but the strongest spray.

The Codling Moth has this season been present in practically every orchard, where apples and pears are grown, in this district. But, notwithstanding, I am convinced that co-operative efforts in opportune spraying, and the cleansing of sheds, &c., will deal an effective blow to this serious pest.

2. *Tomato Caterpillar* (*Chloridea obsoleta*).—Considerable damage has been caused during the latter end of this season by the Tomato Caterpillar (*Chloridea obsoleta*). This insect also attacks cotton and corn (maize). It has been fully described and illustrated by Mr. H. Tryon (Government Entomologist and Pathologist) in a recent published pamphlet, "Insects Injurious to Cotton." This bulletin can be obtained from the Department of Agriculture and Stock, Brisbane, or from this office.

The moth (the final phase in the life of this insect) is stout in build, with strong wings, that measure when expanded about 1½ inches. It lays its eggs singly on the young leaves or flowers of the tomato, and on these hatching the tiny caterpillars pass the early stage of their existence feeding externally on the leaves of the host plant; and, generally when about three-parts grown only, they attack the fruit of the tomato, eating their way right into the inside, and feeding there, comparatively safe from enemies. When full-grown (about 1½ inches long) they leave the fruit and burrow into the soil, where they turn to a shinny brown chrysalis, and this chrysalis in due time gives rise to the moth or perfect insect.

Fortunately, this pest is kept in check in this district by several parasites, both Dipterous and Hymenopterous ones. A small Braconid wasp is one of the most important enemies of the Tomato Caterpillar, and clusters of the small white cocoons of this friendly insect may often be noticed on the leaves, sometimes close to where the caterpillars are feeding, and in some cases attached to a caterpillar. The wasp lays its eggs in the caterpillar, and the wasp-grubs, on hatching, gradually feed on the tissues of their host—this Tomato Caterpillar—and they quickly destroy it. When full-size, they leave the host and pupate outside in clusters. A caterpillar when once attacked soon remains stationary until it dies.

A small Bombylid fly is also a very beneficial insect in aiding in the destruction of the Tomato Caterpillar. This fly I have watched laying its egg on this host (the Tomato Caterpillar), which very much resents the operation, moving thus the posterior end of its body rapidly up and down, apparently to frighten the fly. Many caterpillars collected showed the egg of this fly generally laid near the third or fourth segment. The maggot on hatching from this egg probably works its way into the body of the host, underneath one of the segments or through a spiracle.

Another useful fly, a species of Tachinid, is also doing good work in this district. It has also been observed in the field, ovipositing on Tomato Caterpillars. Most of the Tachinid flies are true parasites, feeding within the host.

Damage from Tomato Caterpillar can largely be controlled by hand-picking and by the use of arsenical sprays. Picking off and destroying the infested tomato fruit is of much importance, and, when this is done early, little loss will result from Tomato Caterpillar; infected fruit can easily be seen, and a man or boy can cover a large area in a day's work. Spraying the plants early in the attack with arsenate of lead paste will also be found beneficial. This should be used at a strength of 2 lb. to 50 gallons of water. If the powder form of arsenate of lead is used, 1 lb. to 50 gallons of water will generally be sufficient to destroy the "worm."

SCALE INSECTS—COCCIDÆ.

The following Scale Insects have been obtained in the Stanthorpe district during the period covered by this report:—

Scale Insect.	Host.	Locality.	Damage.
San José (*Aspidiotus perniciosus*)	Plum and apple	Stanthorpe, Applethorpe	Considerable
Soft Scale (*Lecanium Oleæ*)	Pear, apricot, hazel-nut	Thulimba, Applethorpe, The Summit	No appreciable damage
Soft Scale (*Lecanium berberidis*)	Grape vine ..	Amiens, Stanthorpe ..	No appreciable damage

GENERAL.

Throughout the months of February and March, work in the field and the preparation for winter experiments have occupied much of our time. The care, also, of insect life, &c., in the insectary has claimed a certain portion of each day.

ORANGE-PIERCING MOTHS (Fam. *Ophiderinoe.*)*

By HENRY TRYON, Entomologist.

YEAR after year, during the months of March, April, and May, growers of citraceous fruit throughout the coastal districts of the colony, complain of loss that they experience through their round oranges falling after exhibiting the following symptoms:—On one or more faces they present a bruise-like appearance, and within this area of altered tissue occur small circular perforations through which juice very gradually exudes. This may be remarked even when, though full-grown, they are still green, the site of the injury being characterised by a pale-yellow colouration that is very conspicuous on the general green hue of the rind.

This injury, as shown by a botanist residing at Rockhampton, named A. Thozet, as early as 1869, is occasioned by the attacks of large moths of one or more kinds, belonging to the family Ophiderinæ.

THE MOTHS.—These are named *Ophideres fullonica,* Linné; *Mœnas salaminia,* Cramer; and *Argadesa materna,* Linné.

They are all alike in that they possess the following family characters, being large robust moths, with stout bodies extending not, or slightly, beyond the hindwings. They have both their thorax and hindbody crested and densely clothed. The eyes are large; the antennæ, or feelers, simple and non-pectinated. The fore and hind wings are strongly contrasted, owing to their different colours. The former are dark-hued, exhibiting dark-olivaceous green, brown, or greyish mauve ground-colour or pattern, whereas the hindwings are always bright orange-yellow and more or less marked with black. The expanse of the forewings is from $2\frac{1}{2}$ inches to nearly 4 inches, according to the sex or species. They are, therefore, both large and conspicuously handsome insects.

Mœnas salaminia, Cramer (Plate 72, Fig. 1), unlike the others mentioned, has the outer border of the forewings straight and plane, instead of being arched and scalloped as with them. It is also exceptional in having these organs dark-green with golden reflections, and in having a broad purplish-grey band along the anterior border and a narrow similar band on the outer. In its case both sexes are alike in general appearance.

Othreis fullonica, Linné (Plate 71, Figs. 1 and 2), has the forewings more sharply pointed than are those of either of the other species considered; their external border is, moreover, strongly bowed, though not scalloped (as in *A. materna*). Two lines, also arising at $\frac{1}{4}$ and $\frac{3}{4}$ respectively along the fore-border cross the wing-surface and tend to converge on the hind-border, dividing the wing-surface, of rich dark-brown of different shades on a pale mauve-grey ground colour that is here displayed, into well-marked inner, middle, and outer areas. The male (Plate 71, Fig. 2) in this species is readily distinguished from its consort by the more or less uniform livery of its forewings, that are dark ferruginous or vinous brown. Moreover, in the female, the outer of the foregoing lines is toothed or dentate, instead of being evenly curved, and has a white triangular blotch in one of its denticulations pointing inwards; there occurs also a conspicuous sub-triangular dark-brown blotch in the centre of the wing.

* Reprinted from Q.A.J., Vol. II., O.S., pp. 308-15, 1898.

PLATE 71.—*OTHREIS FULLONICA*, LINN.
(Male and Female.)

PLATE 72.—*MÆNAS-SALAMINIA*, FABR.
ARGADESA MATERNA, LINN. (Male and Female).

Argadesa materna, Linné (Plate 72, Figs. 2 and 3). In this insect the forewings are, externally, both arched and scalloped. They are also greenish-grey, covered with olivaceous-brown or purple-brown, transverse, confluent, diminutive stripes; in the centre of the wing also are four purple-black spots (corresponding in position to the triangular dark-brown discal mark of *O. fullonica*). The female (Fig. 3) is distinguished from the male in having the minute stripes of colouration of a deeper colour, and in exhibiting, also on the forewings, beneath the central dark spots, a conspicuous white bar that is directed obliquely outwards.

In both sexes of the three insects the hindwings are orange-yellow with each a broad black marginal band and a black—usually half-moon shaped—central or discal large patch; the former including also a marginal row of white spots. In *Argadesa materna* this marginal band occupies a greater extent of the hindmargin of the wings than it does in the other insects; moreover, the discal patch is rounded instead of being semilunar, as in their case.

THE CATERPILLARS (Plate 73.).—All three insects have caterpillars of similar cylindrical form, measuring two or more inches in length—when fully grown. They have the 11th segment of the body considerably humped. Otherwise they are quite even and smooth. They are unclothed, save for the presence of minute hairs. Like other Noctuæ, they have each eight pairs of legs—viz., three thoracic clawed, and one terminal, and four intermediate unclawed ones—the anterior pair of the last group being rudimentary. In each case also the caterpillars vary in colour at different periods of their growth, but have in common two large spots or ocelli on either side of the body occupying nearly the entire breadth of the 6th and 7th segments. These spots are very conspicuous, being white and often coloured with very marked hues.

In the case of *Ophideres salaminia*, the full-grown larva is, as stated by A. W. Scott, ''throughout of a deep rich velvety-black, minutely powdered with small spots of pale-blue and straw-coloured.'' Moreover, the eye-spot or ocellus is very gaudy, ''possessing a black pupil with a blue centre, and an iris yellowish above and saturnine-red below.'' Further, ''the penultimate segment bears a reddish prominence, from which proceeds along each side a delicate tracery of white, resembling the fine fibrous roots of a plant.'' Examples of this caterpillar are also occasionally of a dull-reddish hue, and exhibit some variation as regards detail in the markings that they present.

The caterpillars of *Othreis fullonica* (illustrated by photo-lithography on Plate 73) are of shades of rich brown, varying greatly in intensity, in different examples, especially such as exhibit diverse ages. They have also numerous small creamy-white black-edged spots and bars, on the upper surface of the body, that tend to coalesce in places. The large eye-spots are, however, as a rule, far less gaily coloured than is the case in *O. salaminia*, being often wholly white and black.

THE CHRYSALIS.—The chrysalis (Plate 74, Fig. 2) is of a very dark-brown colour with usually a purplish cast. It is somewhat roughened anteriorly. Its tail end is blunt, and at its opposite extremity it is obliquely truncated. That of *O. salaminia* may attain a length of nearly an inch.*

RANGE OF OCCURRENCE.—All three insects have a widely extended range of occurrence beyond the confines of the Australian continent.

HABITS.—The eggs are deposited upon the foliage of the plant or plants destined for the support of the caterpillars to which they give rise.

Food Plants.—These food plants comprise several distinct species of Menispermaceæ—twiners with usually large orbicular or ovate-cordate leaves growing as a rule in the scrubs. Local observations, conducted by Messrs. F. P. Dodd, T. Batcheler, and the writer, prove that the following are included in this category. Representations of the foliage of the several ones described, in each case reduced in size, are given on Plate 75:—

(1.) *Pericampylus incanus*, Miers, or Moore's *Cocculus* (as obligingly identified by the Colonial Botanist, F. M. Bailey, F.L.S.), Plate 75, Fig. 4. A widely-extending rampant climber with smooth, bright-green ''vines,'' along the course of which occur alternately, at rather remote intervals, usually large leaves. In the case of the young growth both the stems and leaf-stalks, as well as the leaves—their upper surface especially—are hispid with short erect pale tawny hairs; but these are lost with age, so that the plant becomes ultimately smooth and glabrous.

* Coloured representations of the above-mentioned caterpillars and chrysalises, with more or less full descriptions, are given by F. Moore in ''The Transactions of the Zoological Society of London,'' Vol. XL., Plate XII., Figs. 3, 3a, 36; and by the same authority in Vol. III. of the ''Lepidoptera of Ceylon,'' p. 134, and Plate 161 (1884). Similarly, *O. salamania* is dealt with in A. W. Scott's ''Australian Lepidoptera and their Transformations,'' Vol. II., Part X., pp. 6-7, Plate XI. (1890).

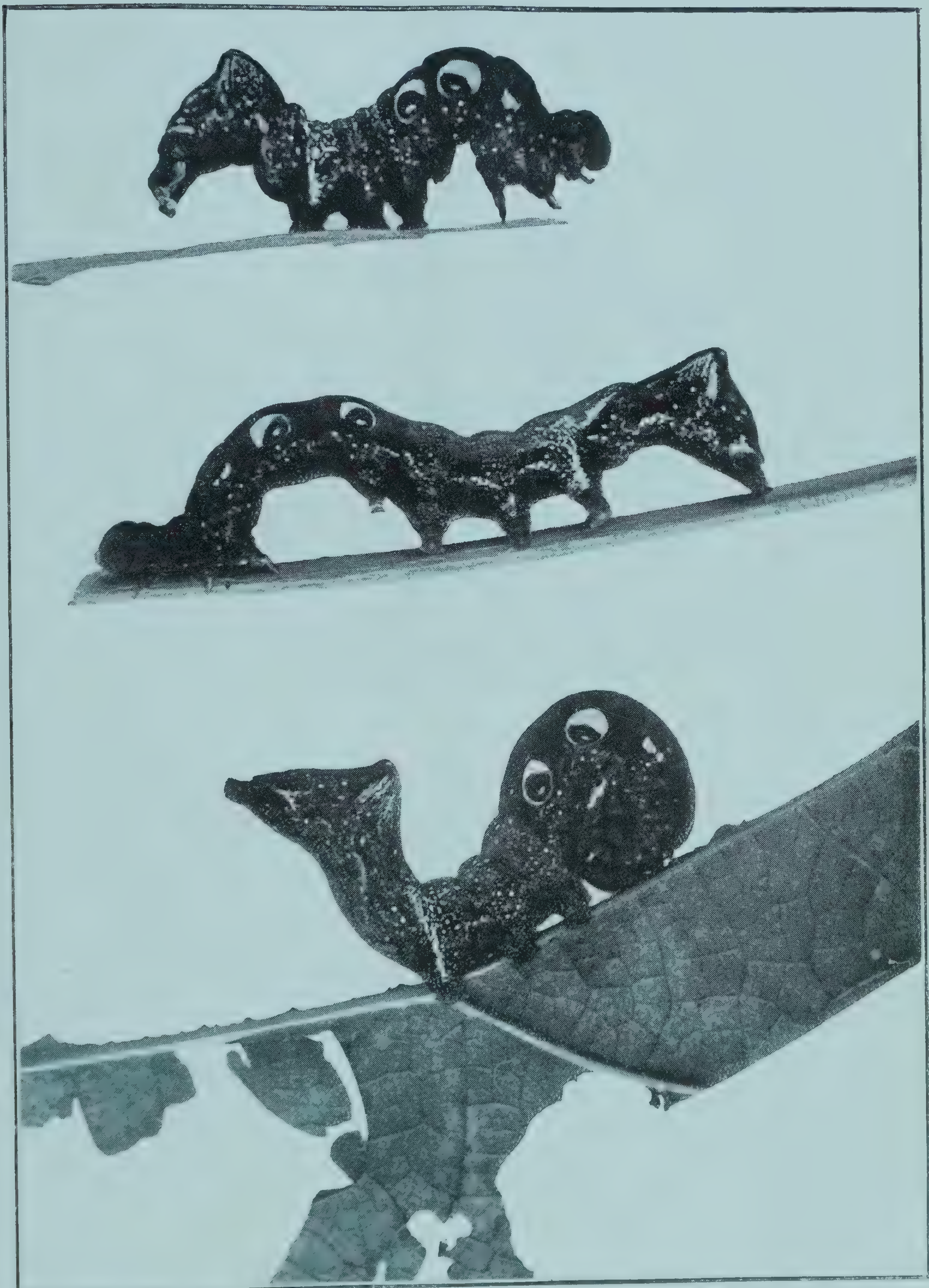

PLATE 73.—*OTHREIS FULLONICA*, LINN.

The leaves are provided with leaf-stalks (petioles) from 4 inches to 6 inches in length, and these are suddenly thickened at their points of attachment with the stem. They are broadly ovate—when old sometimes almost orbicular—and apiculate or tipped with little points. Occasionally—especially in young plants—they are excavated or lobed at the base. They may attain a measurement of 7 inches by 6½ inches, but are usually somewhat smaller. Above they are dark glossy-green with paler veins; beneath they are sage-green or glaucous, with the raised veins yellowish-white. These are raised, and radiate from the point of attachment with the leaf-stalk to the margin, being connected with numerous irregular veinlets. The flowers are small, green, and inconspicuous, and occur on branched stalks in the axils of the leaves. The fruit is a red-coloured berry (drupe), measuring 4 to 6 lines in length, and includes a small round compressed stone. This food plant was indicated by T. Batcheler as one to which *O. fullonica* is especially partial. (For a full description the reader is referred to Mueller's "Fragmenta," Vol. I., pp. 162-3; Melbourne, 1858-9.)

(2.) *Stephania hernandiæfolia*, Walp. (Plate 75, Fig. 1). A winding climber that may reach several feet from the ground, when the support of neighbouring bushes is available, but that otherwise forms dense low masses. The stems or vines are slender, brownish hued, and faintly furrowed. The leaves are alternate on the stems and, placed somewhat distantly from one another, are broadly-ovate or almost orbicular, suddenly narrowed to a point at the end, and measuring from 2½ inches to 3½ inches. They have a somewhat fleshy consistence, and their under-surfaces are paler green than their glossy upper ones, and slightly velvety or pubescent, owing to the presence of numerous short whitish hairs. The leaf-stalk is from 2 inches to 3 inches long, peltately fixed—*i.e.*, inserted at a point situated well (usually ¼-inch) within the leaf margin. The primary veins or nerves are raised, and radiate from the point of attachment of the stalk, being from 8 to 10 in number. The flowers are minute, and occur in umbels on short stalks in the axils of the leaves. The fruit is orange-red and smooth, and measures about ¼-inch in length. This plant seems to be especially common on shaded rocky declivities along the sea-coast, where it may form dense masses. (For a full description, the reader is referred to F. Mueller's "Plants Indigenous to the Colony of Victoria," Vol. I., pp. 220-221, Melb. 1860-2, and to more recent publications. It appears also to be the plant figured in A. W. Scott's "Australian Lepidoptera and their Transformations," Vol. II., Part 1, with the designation *Sarcopetalum Harveyanum*).

(3.) *Stephania aculeata*, Bail. "The Prickly-stemmed Stephania." (Plate 75, Fig. 3). This is also a climbing plant, but one of much more slender habit than is *P. incanus*. Its stems and leaf-stalks are armed with thickly-set fine, brownish-coloured spines, each measuring about ⅛ inch in length. The leaves are of a pale-green or bluish-green colour, have rounded lateral angles, and are gradually narrowed towards the tips. They are, moreover, peltate, having the point of attachment of their stems placed some distance (about ¼-inch) within the margin. They may measure from 3 inches by 2½ inches, but are usually smaller. Their veins also have a radiate arrangement. According to F. M. Bailey, the male flowers are minute, and occur in cymes, the hair-like branches of which bear bracts in the axils of the leaves. Both the female flowers and fruit have not hitherto been described. (For a full description, except for the last-mentioned exception only, reference may be permitted to F. M. Bailey's "Contributions to the Queensland Flora," Bulletin 9, page 7; Department of Agriculture, Brisbane, 1891.) Though evidently not an uncommon plant in the scrubs adjacent to Brisbane, its appearance was, it seems, overlooked till November, 1887.

(4.) (?) *Tinospora smilacina*, Benth.* (Plate 75, Fig. 2.) A fourth food plant, to which this name is provisionally attached, is figured on Plate XII. It is of more slender habit than either of the others described, and the 5-nerved leaves are longer. The material available for description is, however, meagre, and cannot be immediately supplemented. J. G. Luchmann stated regarding it, and having the material figured alone before him—"As you correctly observe, it looks like a Menispermaceous plant (though it may be something else). . . . It greatly resembles *Tinospora smilacina*, but that plant does not extent as far south as Moreton Bay, and has, as a rule, blunter leaves."

The caterpillars (as also shown in the photographic illustration embodied in Plate 73.) when at rest assume many strange attitudes. They may support themselves from one or other extremities of the body, or even hold the head and tail up at the same time. When resting on their abdominal feet, moreover, they are wont to curve their head under so that its top may come in apposition to their chest.

* The discovery of this plant as a food plant of *Othreis fullonica* is due to F. P. Dodd, to whose extensive knowledge of the Lepidopterous fauna of Queensland the writer is under many obligations.

PLATE 74.—*OTHREIS FULLONICA*, LINN.
(Chrysalis in leaf and isolated.)

PLATE 75.—FOLIAGE OF FOOD PLANTS OF ORANGE MOTHS.

When molested they may successively assume different attitudes, jerking their bodies to one side or the other; or, as usually happens, throw themselves to the ground. They are somewhat voracious feeders, and individual specimens will partake of several different species of Menispermaceous plants without apparent detriment to their vitality. According to the observations of T. Batcheler, it would appear that many become full grown ("full fed") in about three weeks from the time of hatching.

When this event has happened, the caterpillar fastens adjacent leaves of its food plant together, or fragments of these, and, within the enclosure thus obtained, spins a very delicate cocoon of white silk, attaches itself by its tail, and then passes into the chrysalis state (*vide* Plate 74, Fig. 1). About three weeks elapse before the moth emerges from its chrysalis.

The last-mentioned observer is of opinion that the insects, or at least *O. fullonica*, pass the winter as moths, since he has met with much faded—evidently, therefore, old—specimens about as early as September; and that the hibernated females, laying their eggs in spring, give rise to the small brood that is to be met with in South Queensland in November and December. T. Batcheler also states that after December there is a succession of broods until May, straggling examples occurring up till the 18th of that month. They are very strong fliers, and pass with facility over long distances in quest of food for themselves or of the plants on which to lay their eggs. Thus P. McLachlan records having taken *A. materna*, Linn., at sea 300 miles from Mauritius, the nearest land (Proc. Ent. Soc. Lond. 1877, page 5).*

According to the observations of T. Batcheler, both *O. fullonica* and *Mænas salaminia* are on the wing principally between the hours of dusk and 11 p.m.† What is the term of existence of the perfect insect is not known, but it has been remarked by the writer that the same insect may occur at night in the same spot during a period of several days. Though they may travel in the first instance long distances to attain food that is provided for them, and thus a far distant growth of a Menispermaceous food plant serve to afford pests for fruit trees close at hand, there are grounds for concluding that having once reached this goal they are addicted to remain in its neighbourhood for some time, since they have been observed sheltered in dry brushwood in the neighbourhood of orchards, and where they could not have originated. On the other hand, orchards that adjoin scrubs in which Menispermaceous plants occur—and whence it may be inferred the moths emanate—suffer as a rule to a greater extent from the special depredations that they occasion than do others that have no such environment.

The habit of the moths, however, which has led to this communication, is that of boring with their horny probosces, or antilia, through the rind of the ripe or ripening orange for the purpose—that they thus accomplish—of imbibing the juice of the fruit. Several not infrequently alight on a single orange with this object, and are to be observed with their probosces still inserted deep into the rind, so that their capture may be readily accomplished. As a result of these injuries, that in great part consist in air being admitted to the fruit-pulp beneath the rind, the orange drops to the ground and quickly rots.

Some have denied, as is more particularly set forth in the concluding section of this article (*vid.* p. 396), that these moths perforate the fruit themselves, as they regard this action on their part as a physical impossibility. On the other hand, they assert that the moths, though they visit the fruit and imbibe its juices, yet avail themselves of the holes that have been already made by other insects, and thus suck the juice through channels in whose preparation they have taken no part. The only insects, however, that have been specifically mentioned as probable precursors of these attacks are the ordinary Fruit Fly and an orange-frequenting Green Plant Bug with thornlike expansions on each side of its thorax—a species of *Rhynchocoris*. The latter, however, restricts its attention to green immature fruit, which it certainly probes; and the former, or Fruit Fly, though it may no doubt occasionally act

* This facility for making long excursions, coupled with the general partiality of their caterpillars for several different plants comprised within a single order—*i.e.*, Menispermaceæ—coupled with the fact that such plants themselves have a wide extra-Australian range of occurrence (*Stephania hernandiæfolia* being found, according to Messrs. G. Bentham and F. Mueller, "from Eastern Africa, almost all over India and the Archipelago, and northward to China," and *Pericampylus incanus*, also, being "common in Eastern India, India, and the Malayan Archipelago, extending northward to South China"—*vid.* "Flora Australiensis," Vol. I., pp. 56 and 58), explains the fact that the species of Ophiderinæ that are met with in Queensland also occur in several far distant lands.

† However, the moths are not attracted by light.

in the capacity referred to, and the moth avail itself of a means of access to the juice of the fruit that it has provided, does not invariably do so, for it generally happens that damaged fruit harbours neither eggs nor fly-maggots, a fact ascertainable by direct observation, and inferred from the circumstance that fruit flies cannot invariably or even often be reared from damaged fruit, which would be otherwise were the ovipositor or egg-placer of the fly the exclusive agent in making the perforation.

As concerning the allegations that it is a physical impossibility, it should be borne in mind that F. Moore, the able monographer of the Ophiderinæ, whilst referring to the exercise of this habit in *Othreis fullonica,* does not express any doubt regarding the accuracy of the observations that have given rise to the narrative that he quotes; nor, indeed, does he question the ability of the moth itself to perform the mechanical operations that such depredations as have been attributed to it involve. Moreover, the curious and exceptionally formed proboscis (or applied maxillæ) has been shown by a French naturalist, J. Künckel d'Herculais, not only in the case of *Othreis fullonica,* but also in those of *A. materna, M. salaminia,* and *O. imperator,* as well as other species, to be specially and exceptionally adapted to *this end.**

This proboscis, or antilia, is made up of two applied maxillæ, and about one-eighth part of its length is occupied by the teretron or borer. This is a double organ, consisting of two similar halves. One of the halves, or what really is the end of a maxilla, is thus described by Dr. R. B. Read, of Sydney, whose account of it is here given to escape the generally undesirable act of translating an author's description, as would have been necessary in making use of Künckel d'Herculais' memoir; and since it is most accurate with regard to detail:—

Upper and Outer Surface.—Tip acutely pointed, expanding upwards into three barbs, two of which, the first and third, are placed on the outer side, whilst the second is intermediate between them, and next the line of junction with the maxillæ. From the barbed portion the terminal begins to expand, and on its upper surface is presented, in a line above the second barb, a curved projection terminating abruptly, showing a sharp oval gauge-like edge; the interior of the projection is sharply hollowed out, and from it arises a large rounded tooth-like process. From this point commence two or more rows of thickly-set setæ, which continue the whole length of the antilia (the two applied maxillæ, or proboscis). Above and on the outer side of the terminal is placed, diagonally, a second process similar to that already described, whilst above in a line between the first and second, occurs the third. The fourth is placed above, and in a line alternating between the second and third. The fifth is similarly placed in relation to the third and fourth; and the sixth and last in respect of the fourth and fifth. Each superior process is slightly larger than that below it. At the base of the sixth process, in a slightly cupped hollow, is a solitary long spine, whose office may be to prevent the teretron being plunged too deeply into fruits to permit of withdrawal.

Under Surface.—Tip acutely pointed, expanding upwards, then suddenly contracting, gives a sharp transverse ridge one half-way up the barbed portion, which again expands upwards and outwards and forms a second sharp-edged transverse ridge. The remainder of the terminal is divided unequally into three divisions, each of which presents a very strong, sharp, lancet-like process. At the junction of the terminal with the remainder of the maxillæ are set diagonally upwards and outwards four conically-shaped spines; then, a space intervening, there is placed higher up the maxillæ a set of three similar spines; after a longer interval a set of two spines occurs, and finally a single spine is placed at a considerable distance from the last two, making ten in all placed like the teeth of a long harrow.

Furnished with this extraordinary apparatus (Dr. Read concludes) these species of Ophideres are able to pierce the skin of the orange even before it has turned yellow, two of them sometimes attacking the same fruit.†

Having seen, then, with how perfect a boring apparatus these moths are provided, it would seem highly probable on *a priori* grounds, were no observations as to the manifestation of the habit forthcoming, that they would not adopt exclusively the procedures referred to in gaining access to the juice of the orange, but might

* Les Lepidopteres, à trompe perforante, destructeurs des oranges. Compt. Rendus, 61, Paris, 1875, pp. 397-400, and Plate.

† Read (Dr. R. B.). "Lepidoptera having the Antilia terminated in a Teretron or Borer." Proc. Lin. Soc. N.S. Wales, Vol. III., 1879, pp. 150-154, accompanied by a carefully-executed Plate.

rather oftentimes perforate its investing rind; that when an individual moth found no previous channel into the pulp, or, in the case of several moths simultaneously visiting a fruit, a sufficient number, it would bring the borer into requisition.

Insects might, perhaps, be mentioned that are endowed with more efficient penetrating organs than are those of the species of Ophiderinæ; but then, conjoined with evidence of the possession of these is required, from those who deny that moths can perforate fruit, proof that these specially favoured insects, on their part also, manifest this habit. But of the insects that seek admission to the pulp of the orange as directly affording them food, or as furnishing a nidus in which to deposit their eggs, the writer knows of none as competent as are the so-called orange moths to effect a passage through the rind.

In Queensland these moths do not confine their attention to oranges. Some seasons back it was reported that at Glen Prairie, near Rockhampton, a moth, that proved to be *Ophideres fullonica,* was making great havoc amongst the mango fruit, by alighting on it and extracting its juice. From other parts Orange Moths are reported as damaging bananas in a similar manner. In the vicinity of Brisbane, at a time when ripening oranges are only exceptionally, if ever, to be found, the writer has seen these moths amongst grape-vines loaded with ripe fruit, and, as elsewhere remarked by him, the ready way in which some grapes, notably the Black Hamburg, shed their fruit may be possibly ascribed in some cases to the fact that Orange Moths have visited the bunches.

For further information on this subject reference may be made to an elaborate paper contained in the "Quarterly Journal of the Microscopical Society," Vol. XI., 1875, entitled "On the Structure of the Proboscis of *Ophideres fullonica* or Orange-sucking Moth." In this F. Darwin not only recites A. Thozet's observations, but also gives a *resumé* of an article by ——. McIntyre published in the "Monthly Microscopical Journal," of May, 1874, on boring Lepidoptera of the Cape of Good Hope, the proboscis of one of which resembles, as is stated, to some extent that of *O. fullonica* described and figured by M. Künckel, and is competent to penetrate the skin of the hand when attempt is made to grasp the insect possessing it.

REMEDIES.—(1.) By means of the cane or scrub knife cut off at the roots all plants which it may be concluded, by direct observation, support the caterpillars, or moths in their immature state, or that may be identified with food plants from the descriptions previously given (pp. 390 and 393), and growing in scrubs or on rock banks in the vicinity of orange orchards, and destroy at the same time whatever caterpillars or chrysalises may be thus encountered.

(2.) Where it is practicable, and economically justifiable, destroy the entire woody vegetation where such food plants may be expected to exist.

(3) Remove all brushwood from the vicinity of orange orchards, that the moths may have little or no harbouring places in the intervals between their nocturnal visitations.

(4.) Afford, if practicable, a counter-attraction; and capture or net the moths thus diverted from pursuing their destructive work. They are especially partial to highly flavoured bananas of the Cavendish type. Thus, suffer to remain on one or two of the latter plants, if growing conveniently, as many bunches; till the over-ripe fruit drops to the ground. Or, preferably, hang in places that can be conveniently visited, wrapped in calico, small bundles containing similarly conditioned fruit of this descripton—five or six bananas in each. These to be nightly visited with lantern and net in hand, when the not-readily-disturbed Orange Moths amongst others may be captured.

(5.) Poison the moths by impregnating the bananas with a syrup containing a small proportion of arsenite of potash made by boiling equal weights of white arsenic (arsenious acid) and bicarbonate of potash in water. Sixty-four grains of each of the chemicals named to 4 oz. of water form convenient proportions for the manufacture of the poison.

It must, however, be borne in mind that the best results may be obtained by beginning operations long before the season for oranges commences. From what has been already stated (*vid.* p. 393) the early broods of the insect—viz., those that occur before the end of December—are comparatively small, but from them arise, by accessions with the birth of each successive brood, the very large numbers that visit orangeries notorious for injury to their fruit of the nature described.

HISTORICAL.—The subjoined statement, since it serves to show the part played by one of Queensland's pioneer and ablest scientific workers in elucidating the facts narrated, and also bears upon the subject dealt with, may be not altogether devoid of interest to those who may feel induced to further prosecute this inquiry.

The fact that one of the moths mentioned—viz., *Ophideres fullonica*—injured oranges in the manner described was discovered as early as 1869 by A. Thozet, a French botanist resident at Rockhampton, and recorded by him in the Rockhampton *Bulletin* of that year. In 1871 he further made this known to Mons. J. Künckel d'Herculais, assistant naturalist at the Paris Museum of Natural History, accompanying his statement with illustrative examples of the insect concerned. Again, in May, 1875, the destructive rôle enacted by these insects was again enlarged upon by A. Thozet in a communication over the signature "Pomona," appearing in the Rockhampton *Bulletin* of — May and the *Capricornian* of 8th May.

The well-known Queensland lepidopterist, W. H. Miskin, disputed this finding in a letter "On Insect Enemies of the Orange," printed in the *Queenslander* of 22nd May, 1875. To this "Pomona" furnished an able reply, dated 10th June, 1875, that appeared in the Rockhampton *Bulletin* of that month.

This controversy between A. Thozet and W. H. Miskin, in 1875, having been in due course brought under notice of d'Herculais, he was now induced to again consider the former's allegations, and, as part of his inquiry, to examine the proboscis or sucking organ of the moth to which it referred. This renewed investigation on his part then brought to light the marvellous and exceptional structure that it exhibited, and that seemed to answer so well to the function of piercing comparatively hard substances that had been attributed to it by Thozet. This he made known in a special memoir entitled "Les Lepidopteres, à trompe perforante, destructeurs des oranges," that was communicated by Emile Blanchard to the French Academy of Sciences, on 3rd August, 1875, and printed in the annals of that society (*vid. Compt. Rendus* 61, Paris, 1875, pp. 397-400, and Plate).

F. Darwin also on his part described this strangely fashioned piercing organ of *Ophideres* in the "Quarterly Journal of Microscopical Science" for 1875, and wrote on 22nd August to A. Thozet, "congratulating him on his discoveries," remarking that they supported his own observations on the habits of *Phalenes* that perforated the nectaries of certain flowers.

M. Künckel d'Herculais' paper, that created very great interest amongst scientific men, is reprinted in the "Annals and Magazine of Natural History" for 1875 (*vid.* 4 Series, Vol. XVI., pp. 372-4, 1875), and also summarised in the "Gardeners' Magazine" for the same year. It was also incorporated in an able paper read before the Paris Acclimatisation Society by Mons. Aime Dufort shortly afterwards. Dufort's paper has been made known to Australian readers, for, having been translated into English by the editor of this *Journal*, A. J. Boyd, and communicated to the *Queenslander*, it appeared in its issues of 14th July and 21st July, 1877.

Prior, however, to the important discovery being made known in the colony, another Rockhampton correspondent (G. L. Pilcher) had also publicly disputed A. Thozet's contention, in a letter dated 23rd March appearing in the *Queenslander*, 7th April, 1877; and his views on this subject, having been meanwhile communicated to a well-known British entomologist, found expression also in "Cistula Entomologica" of 1877, pp. 237-40.

W. H. Miskin, as referee to the *Queenslander* on entomological topics, again impugned the accuracy of A. Thozet's observations in the *Queenslander* of 11th May, 1878, without comment, however, on the confirmatory discoveries on the part of d'Herculais and F. Darwin. Thozet, however, found a local champion in Robert Grieve, who also wrote to the *Queenslander* on "The Enemy of the Orange," narrating similar observations made in the vicinity of Brisbane to those that the former had made at Rockhampton.

In 1879 Dr. R. B. Read, of Sydney, published his independent researches on "Lepidoptera having the Antilia terminated in a Teretron or Borer," in a paper, already quoted, read before the Linnean Society of New South Wales, and appearing in Vol. III. of its "Proceedings" (*op. cit.*, pp. 150-154, 1879). In this appears an excellent figure of the distal extremity of the proboscis of *Ophideres fullonica* and *O. salaminia*.

Again, the present writer discussed the whole subject fully in 1889, in an article entitled "Orange Moths—Fam. Ophiderinæ," appearing in his Report on Insect and Fungus Pests (*op. cit.*, pp. 101-104, Brisb., 1879).

Finally, the same theme is briefly dealt with from another point of view by A. Sidney Olliff and H. Forde in A. W. Scott's "Australian Lepidoptera and their Transformations" (*op. cit.*, Vol. II., Part I., pp. 6-7, 1890).

DESCRIPTION OF PLATES.

PLATE 71.—*Othreis fullonica*, L. Male and female. (Original.)

" 72.—*Mænas salaminia*, Cram., and *Argadesa materna*, L. Male and female. (Original.)

" 73.—*Othreis fullonica*, L. Caterpillars from life. (Original.)

" 74.—*Othreis* chrysalis. Natural mode of occurrence and isolate. (Original.)

" 75.—Foliage of Menispermaceous food plants of Ophiderinæ. Dimensions reduced. (Original.)

(1) *Stephania hernandiæfolia*, Walp.

(2) (?) *Tinospora smilacina*, Benth.

(3) *Stephania aculeata*, Bail.

(4) *Pericampylus incanus*, Miers.

PLATE 76.—SUGAR-CANE GROWING ON MR. H. SANDERSON'S FARM, NORTH DEEP CREEK, GYMPIE, PHOTOGRAPHED SIX MONTHS TO THE DAY AFTER PLANTING.

It is Hambleton Seedling Variety.

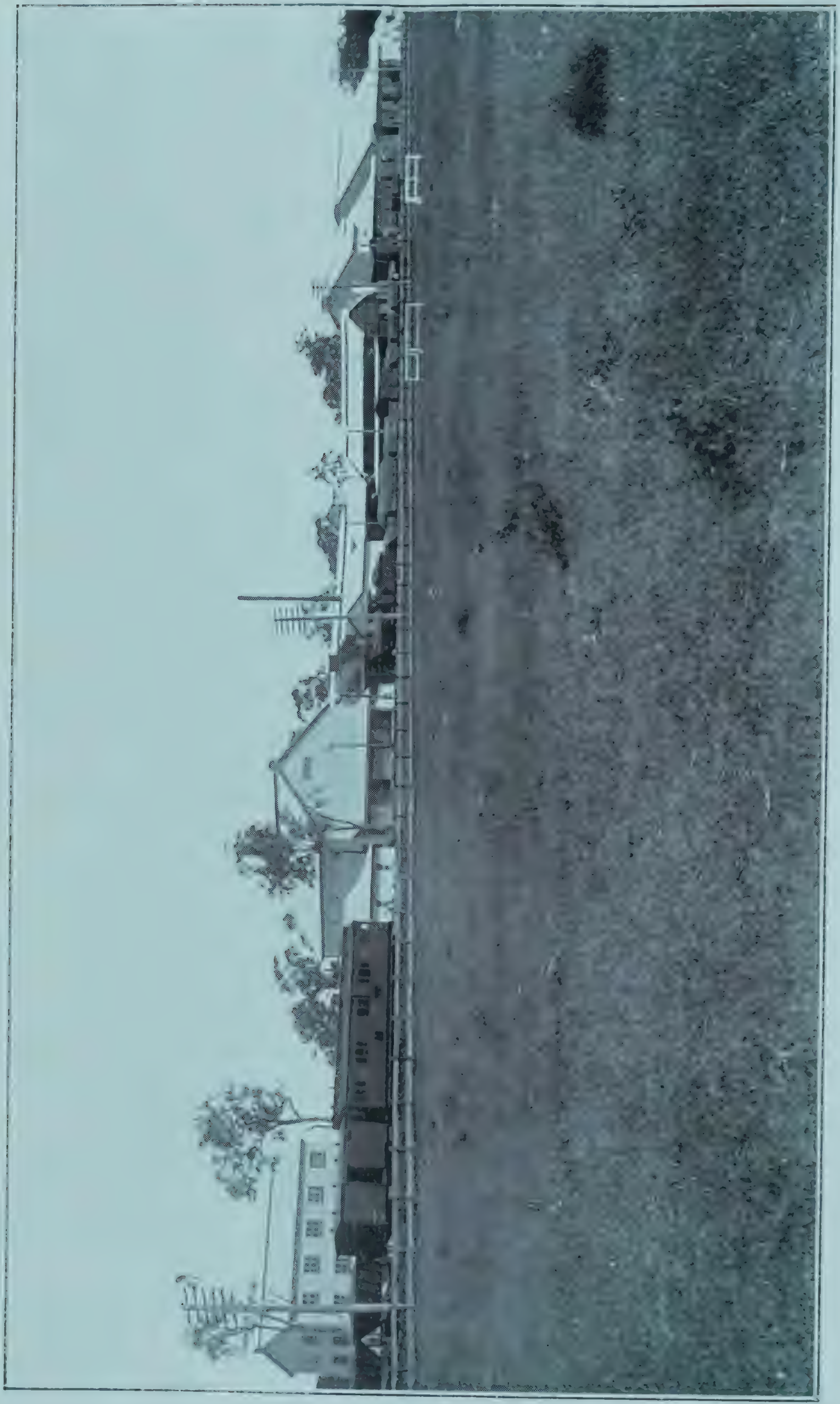

PLATE 77.—COTTON GINNERY AND COTTON SEED OIL MILL, WHINSTANES, BRISBANE.

General Notes.

Native Bears and Opossums—Close Season Extended

The close season for native bears and opossums has been extended, and will now end on the 30th April, 1925, instead of on the 30th April, 1924.

The Pink Boll Worm.

The Acting Minister for Agriculture (Hon. W. Forgan Smith) has announced the adoption of an Order in Council declaring that the Pink Boll Worm is a pest in any district in Queensland, and that the presence of the Pink Boll Worm in or about any cotton plant is a disease under the Cotton Industry Act.

Staff Changes and Appointments.

The resignation of Mr. R. J. S. Muir, Canegrowers' Representative on the South Johnstone Local Sugar Cane Prices Board, has been accepted, and Mr. G. F. Hudson appointed in his stead.

The resignation of Mr. A. B. Clarke, Canegrowers' Representative on the Marian Local Sugar Cane Prices Board, has been accepted, and Mr. J. J. Hedrick appointed in his stead.

Police Constable G. R. Spencer has been appointed an Acting Inspector of Stock.

The appointment of Mr. R. R. Anson as Assistant Instructor, Cotton Section, Department of Agriculture and Stock, has been confirmed as from the 4th October, 1923.

Cane Pest Boards.

The Plane Creek Cane Pest Board has now been constituted as under:—Millers' representatives: Messrs. A. Innes and J. C. Nicholson; canegrowers' representatives: Messrs. S. F. Dent, R. A. McKie, and A. Patterson.

Messrs. C. D. Clarke, J. T. O'Riordan, F. J. Stevens, G. F. Williams, and R. G. Johnson have been nominated as canegrowers' representatives for the Mackay Cane Pest Board, and as the number exceeds the number to be elected—viz., three—a poll will be taken on the 15th May, 1924, closing at 12 o'clock noon.

Registered Co-Operative Companies.

A notice has been issued declaring the following companies to be companies in accordance with "*The Primary Producers' Co-operative Associations Act of* 1923":—

Palmwoods, Montville, & Buderim Amalgamated Fruitgrowers' Society, Limited;

Stanthorpe Co-op. Canning, Jam, & Preserving Coy., Ltd.;

Pikedale Soldiers' Settlement Co-op. Canning, Jam, & Preserving Coy., Ltd.

Queensland Co-operative Fruit Products Ltd.; and

Woombye Fruitgrowers', Limited;

and Regulation 56 under the Act fixes the date of meeting of such companies as Saturday, the 10th May, 1924.

Sugar Assessment Levy.

In accordance with the provisions of the Sugar Experiment Stations Act, the Secretary for Agriculture and Stock has levied an assessment at the rate of one half-penny on every ton of sugar-cane received at sugar-works during the season 1924-25, such assessment to be payable by the owners of sugar-works in the first instance, and an Order in Council under the Regulation of Sugar Cane Prices Acts has been approved, ordering that the assessment which the Minister may make and levy on every ton of sugar-cane received at any mill on and after the 1st May, 1924, is fixed at the sum of twopence per ton.

Messrs. J. H. Cattermull and A. L. McColl have been appointed millowners' representatives on the South Johnstone Local Cane Prices Board, *vice* G. R. Blair and J. J. Cran, appointments rescinded.

Mr. Marmon Devine, of Daymar, S.W. Line, has been appointed an Honorary Inspector of Stock, as from the 5th April, 1924.

Atherton Maize Pool.

The constitution of the Atherton Tableland Maize Pool Board has now been altered. Instead of members holding office for one year only, thus necessitating a complete re-election annually, it is now provided that members remain in office for two years, a section of the Board being elected each year. The three representatives who gain the highest number of votes at the 1924 election will remain in office until 31st March, 1926, but the two representatives obtaining the next highest number of votes are to be appointed for one year only. Two representatives shall be elected in 1925, 1927, 1929, and 1931, each for two years; and three representatives in 1926, 1928, and 1930, also for two years. In 1932 the three members elected will hold office until 30th June, 1933.

Mr. A. B. Tanner, Nambour, has been appointed an Honorary Inspector under and for the purposes of the Diseases in Plants Act.

The resignation of Mr. R. G. Patullo, Inspector under the Diseases in Stock Act at Kingaroy, has been accepted.

The resignation of Mr. Jas. A. Clarke, Inspector under "*The Diseases in Plants Act of* 1916," has been accepted as from the 30th April, 1924.

Proposed Queensland Maize Board.

A recent *Gazette* notice states the intention of the Governor, in pursuance of the provisions of the Primary Products Pools Act, to create a Queensland Maize Board. This Maize Board has been recommended by the Council of Agriculture and, if formed, it will be briefly constituted as follows:—

It will take in all maize produced from seed soon after the 1st July, 1923, in any part of Queensland other than the Petty Sessions Districts of Atherton, Herberton, and Chillagoe, which are already attended to by the Atherton Tableland Maize Pool.

The Pool will be in operation for one year from the actual date of constitution and for such extended period not exceeding five years as the Governor in Council (on the recommendation of the Council of Agriculture) may decide.

The Board to administer the Pool will consist of five members together with a person to represent the Council of Agriculture.

In order that there may be no delay in getting the Pool (if constituted) into working order, a Provisional Board is provided. This will consist of—

Messrs. T. F. Plunkett and T. C. Haynes to represent the No. 1 District, which will comprise the Pastoral District of Moreton.

Messrs. B. C. C. Kirkegaard and J. T. Chamberlain, to represent the No. 2 District, which will comprise the Pastoral Districts of Darling Downs and Maranoa.

Mr. J. H. Sigley to represent the No. 3 District, comprising the rest of Queensland with the exception of the Petty Sessions Districts of Atherton, Herberton, and Chillagoe.

The above Provisional Board will hold office until the 31st July, 1924, and in the meantime provision has been made for the election of representatives for the three abovementioned districts.

Nominations for membership on the Board should reach the Under Secretary, Department of Agriculture and Stock, Brisbane, before the 31st May, 1924. The Board thus elected will hold office for twelve months from the 1st August, 1924.

Persons eligible to vote on any referendum or election in connection with the proposed Board subsequent to the 1st July, 1923, and prior to the 31st July, 1924, shall be persons growing at any time subsequent to the 1st July, 1923, maize for grain in any part of Queensland other than the Petty Sessions Districts of Atherton, Herberton, and Chillagoe.

At future referendums or elections the eligible voters shall be persons who grew maize for grain at any time during the twelve months preceding the date of such referendum or election in any part of Queensland, exclusive of the Atherton Tableland as above.

A petition has already been received asking that a ballot be taken to decide whether the Pool shall be created, and the necessary referendum papers are being despatched to growers this week. They must be returned to the Under Secretary, Department of Agriculture and Stock, Brisbane, so as to reach him not later than the 31st May, 1924. Any grower entitled to vote who does not receive a ballot-paper is invited to send his name at once to the Department of Agriculture and Stock, Brisbane.

Close Season for Quails.

The close season for quails will now end on the 31st May instead of the 30th April, 1924, as previously notified.

Ratoon Cotton.

Up to the 16th June, 1924, every grower shall be at liberty to harvest all ratoon cotton and standover cotton on land under his control and dispose of such cotton on the following conditions:—

> For the said ratoon or standover cotton an advance of threepence per pound will be made by the Government if the cotton is clean and free from leaf and stain: provided the grower shall have before the 30th June, 1924, destroyed all ratoon and standover cotton plants on his land. Full particulars of such ratoon and standover cotton must be sent to the ginnery to which it is consigned at the time of despatch, and any ratoon or standover cotton found to be mixed with annual seed cotton in any consignment will entail the rejection of the whole consignment. The Department of Agriculture and Stock will arrange the sale of lint from ratoon cotton and standover cotton upon owner's account, and pay him any excess received over the 3d. a pound, less cost of ginning and marketing.

Every grower, before the 30th June, 1924, must destroy all ratoon and standover cotton plants on his land. After the 30th June, 1924, an inspector shall enter all lands on which ratoon or standover cotton plants remain, and destroy such plants at the expense of the grower. No person shall have any claim for compensation in consequence of such entry and destruction.

Compensation for ratoon bolls or standover bolls which are immature and unmarketable on the 16th June, 1924, may be based upon the difference between the net amount received by the grower for ratoon cotton and standover cotton harvested and disposed of before the 16th June, 1924, and a fair estimate of the net amount which the grower would have received for his crop had he been allowed to continue to harvest up to the 31st July, 1924. The actual amount of such compensation shall be determined by the Secretary for Agriculture and Stock, but no compensation shall be paid except to a grower who has faithfully complied with the terms of this Order.

Every grower having ratoon cotton must, within fourteen days after the making of this Order, furnish the Department of Agriculture and Stock, Brisbane, with the following particulars:—

- Whether he is the owner or lessee of the land on which the cotton is grown;
- What use was made of such land prior to the planting of the crop;
- The area under plant cotton;
- The area under ratoon or standover cotton;
- The total area under cotton cultivation;
- The quantity of all ratoon cotton and standover cotton already harvested during 1924;
- The estimated weight of unharvested ratoon and standover cotton;
- Whether stock had been allowed access to his cotton crops and, if so, on what dates;
- The state of the land—whether properly cultivated or overgrown with weeds; and
- Any other information that may enable the Department to decide the question of compensation.

Any person committing a breach of the Order will be liable to a penalty of £100.

Bunchy Top Investigations.

Since a previous communication concerning the progress of the arrangements with the Commonwealth Government through the Science and Industry Institute and New South Wales respecting arrangements for the investigation into the Bunchy Top disease, advice has been received by the Minister for Agriculture and Stock (Hon. W. N. Gillies) that Mr. McGee, one of the scientists recommended by the committee representing the co-operation, will accept the appointment, and will shortly arrive in Brisbane. The way is now cleared for the commencement of the investigation under the supervision of Professor Goddard, who will, in addition to Mr. McGee, have Mr. Collard of the Department of Agriculture on his staff.

Bunchy Top Investigation.

In the course of a recent announcement, the Minister for Agriculture (Hon. W. N. Gillies) said that at the meeting in February last in Brisbane relating to the investigations into the Bunchy Top disease, Professor Watt, of the Sydney University, Professor Osborn, of the Adelaide University, and Professor Goddard, of the Queensland University, discussed and made recommendations as to the best methods of research. They proposed, among other things, that two scientists be invited to undertake the investigation, but it has been ascertained since that neither gentleman is available; from inquiries abroad it seems that there is a dearth of first-class scientific men available for research work.

At a recent meeting in Brisbane, Sir G. H. Knibbs (Director of the Commonwealth Bureau of Science and Industry), Mr. G. Valder (Under Secretary for Agriculture, New South Wales), Professor Goddard (Queensland University), and Mr. E. G. E. Scriven (Under Secretary for Agriculture) discussed the situation. At a later meeting in Sydney it was decided, subject to the agreement of the Governments of Queensland, New South Wales, and the Commonwealth, that the investigation should be placed with this State, under the supervision of Professor Goddard.

A junior scientist is to be appointed. Mr. Collard, of the Fruit Staff of this Department, has been seconded for service as horticulturist for the research work, and also for any departmental help that can be given. Details have, of course, to be arranged, but now the way is clear no time will be lost in commencing active work. Mr. Collard will visit Fiji to observe conditions there.

Co-operative Associations Act.

A notice under section 24 of "*The Primary Producers' Co-operative Associations Act of* 1923" has been issued declaring a further number of companies carrying on operations of a co-operative nature in relation to primary produce, and a regulation (No. 57) has been promulgated under that Act, requiring such companies to hold meetings on or before the 17th May next.

Co-operative Associations Act—Additional Regulations.

Additional Regulations Nos. 54 and 55 have been issued under "*The Primary Producers' Co-operative Associations Act of* 1923" providing that (54) all associations which signified, prior to the 6th March, 1924, by the production of documents, their intention of becoming registered under the abovenamed Act, shall be accepted for registration on payment of the prescribed fee; and (55) subclause (2) of clause 41 of the Regulations published on the 6th March, 1924, be rescinded and that a subclause be substituted therefor, setting out that persons who have practised as public accountants or persons with experience in auditing accounts, subject to the approval of the Auditor-General, may be appointed as auditors for associations.

Messrs. S. Stevens and P. J. O'Donnell, Land Rangers, Dalby, and Mr. A. H. T. Bedford, Curlew street, Toowong, have been appointed Inspectors, Advances to Settlers Branch, State Advances Corporation, and Mr. F. W. Haynes, Land Ranger, Gayndah, has been seconded to and appointed Acting Inspector, Advances to Settlers Branch, State Advances Corporation, for a period of six months.

Mr. G. Rankin has been appointed an officer under and for the purposes of "*The Animals and Birds Act of* 1921," as from the 10th April, 1924.

Mr. W. Lazenby has been appointed an Honorary Inspector under and for the purposes of "*The Diseases in Plants Act of* 1916," as from the 10th April, 1924.

The resignation of Mr. C. Sheehy, Record Clerk, Department of Agriculture and Stock, has been accepted as from the 29th February, 1924. Mr. Sheehy is now the Assistant Secretary of the Council of Agriculture.

Mr. C. R. H. Jacobson, Temporary Inspector of Dairies, Department of Agriculture and Stock, has been appointed Inspector under the Dairy Produce Act, Department of Agriculture and Stock, as from the 12th April, 1924.

Farm and Garden Notes for June.

FIELD.—Winter has set in and frosts will already have been experienced in some of the more exposed districts of the Southern Coast and on the Darling Downs. Hence insect pests will to a great extent cease from troubling and weeds will also be no serious drawback to cultivation. Wheat sowing should now be in full swing, and in connection with this important operation should be emphasised the necessity of at all times treating seed wheat by means of fungicides prior to sowing. Full directions for ''pickling'' wheat by the Bluestone and Lime treatment are available on application to the Department of Agriculture, Brisbane. Land intended for the production of early summer crops may now receive its preliminary preparation, and every opportunity taken advantage of to conserve moisture in the form of rainfall where experienced; more particularly so where it is intended to plant potatoes or early maize. Where frosts are not to be feared the planting of potatoes may take place in mid-July; but August is the recognised month for this operation. Arrowroot will be nearly ready for digging, but we would not advise taking up the bulbs until the frosts of July have occurred. Take up sweet potatoes, yams, and ginger. Should there be a heavy crop, and consequently a glut in the market, sweet potatoes may be kept by storing them under cover and in a cool place in dry sand, taking care that they are thoroughly ripe before digging. The ripeness may be known by the milky juice of a broken tuber remaining white when dry. Should the juice turn dark, the potato is unripe, and will rot or dry up and shrivel in the sandpit. Before pitting, spread the tubers out in a dry barn or in the open, if the weather be fine. In pitting them or storing them in hills, lay them on a thick layer of sand; then pour dry sand over them till all the crevices are filled and a layer of sand is formed above them; then put down another layer of tubers, and repeat the process until the hill is of the requisite size, and finally cover with either straw or fresh hay. The sand excludes the air, and the potatoes will keep right through the winter. In tropical Queensland the bulk of the coffee crop should be off by the end of July. Yams may be unearthed. Collect divi-divi pods. The opium poppy will now be blooming and forming capsules. Gather tilseed (sesame). Sugar-cane cutting may be commenced. Keep the cultivator moving amongst the pineapples. Gather all ripe bananas.

Cotton crops are now fast approaching the final stages of harvesting. Growers are advised that all cotton in the Central District should be consigned to the Australian Cotton-growing Association, Rockhampton or Gladstone, whichever is nearest; whilst those in the Southern areas should consign their cotton to the Association at Gayndah or Whinstanes, near Brisbane. All bales and bags should be legibly branded with the owners' initials. In this matter the consignor is usually most careless, causing much delay and trouble in identifying parcels, which are frequently received minus the address labels.

KITCHEN GARDEN.—Cabbage, cauliflower, and lettuce may be planted out as they become large enough. Plant asparagus and rhubarb in well prepared beds in rows. In planting rhubarb it will probably be found more profitable to buy the crowns than to grow them from seed, and the same remark applies to asparagus.

Sow cabbage, red cabbage, peas, lettuce, broad beans, carrots, radish, turnip, beet, leeks, and herbs of various kinds, such as sage, thyme, mint, &c. Eschalots, if ready, may be transplanted; and in cool districts horse radish can be set out.

The earlier sowings of all root crops should now be ready to thin out, if this has not been already attended to.

Keep down the weeds among the growing crops by a free use of the hoe and cultivator.

The weather is generally dry at this time of the year, so the more thorough the cultivation the better for the crops.

Tomatoes intended to be planted out when the weather gets warmer may be sown towards the end of the month in a frame where the young plants will be protected from frost.

FLOWER GARDEN.—No time is now to be lost, for many kinds of plants need to be planted out early to have the opportunity of rooting and gathering strength in the cool, moist spring time to prepare them for the trial of heat they must endure later on. Do not put your labour on poor soil. Raise only the best varieties of plants in the garden; it costs no more to raise good varieties than poor ones. Prune closely all the hybrid perpetual roses; and tie up, without pruning, to trellis or stakes the climbing and tea scented varieties, if not already done. These and other shrubs may still be planted. See where a new tree or shrub can be planted; get these in

position; then they will give you abundance of spring bloom. Renovate and make lawns, and plant all kinds of edging. Finish all pruning. Divide the roots of chrysanthemums, perennial phlox, and all other hardy clumps; and cuttings of all the summer bedding plants may be propagated.

Sow first lot, in small quantities, of hardy and half-hardy annuals, biennials, and perennials, some of which are better raised in boxes and transplanted into the open ground, but many of this class can, however, be successfully raised in the open if the weather is favourable. Antirrhinum, carnation, picotees, dianthus, hollyhock, larkspur, pansy, petunia, *Phlox Drummondi*, stocks, wallflower, and zinnias, &c., may be sown either in boxes or open beds; mignonette is best sown where it is intended to remain. Dahlia roots may be taken up and placed in a shady situation out of doors. Plant bulbs such as anemones, ranunculus, freesias, snowflakes, ixias, watsonias, iris, narcissus, daffodils, &c. Tulips will not suit the Queensland climate.

To grow these plants successfully, it is only necessary to thoroughly dig the ground over to a depth of not less than 12 in., and incorporate with it a good dressing of well-decayed manure, which is most effectively done by a second digging; the surface should then be raked over smoothly, so as to remove all stones and clods, thus reducing it to a fine tilth. The seed can then be sown in lines or patches as desired, the greatest care being taken not to cover deeply; a covering of not more than three times the diameter of larger seeds, and a light sprinkling of fine soil over small seeds, being all that is necessary. A slight mulching of well-decayed manure and a watering with a fine-rosed can will complete the operation. If the weather prove favourable, the young seedlings will usually make their appearance in a week or ten days; thin out so as to leave each plant (if in the border) at least 4 to 6 in. apart.

Orchard Notes for June.

THE COAST DISTRICTS.

The remarks that have appeared in these notes for the past two months apply in a great measure to June as well, as the advice that has been given regarding the handling, grading, packing, and marketing of the citrus crops still holds good. As the weather gets cooler the losses due to the ravages of fruit flies decrease, as these insects cannot stand cold weather, and consequently there is only an odd one about. The absence of flies does not, however, permit of any relaxation in the care that must be taken with the fruit, even though there may be many less injured fruit, owing to the absence of fruit-fly puncture, as there is always a percentage of damaged fruit which is liable to speck, which must be picked out from all consignments before they are sent to the Southern States, if a satisfactory return is to be expected. If the weather is dry, citrus orchards must be kept in a good state of tilth, otherwise the trees may get a setback. Old worn-out trees can be dug out and burnt; be sure, however, to see that they *are* worn out, as many an old and apparently useless tree can be brought round and made to bear good crops, provided the trunk and main roots are still sound, even though the top of the tree is more or less dead. The whole of the top of the tree should be cut off and only the trunk and such sound main limbs left as are required to make a new head. The earth should be taken away from around the collar of the tree, and the main roots exposed, any dead roots being cut away and removed. The whole of the tree above ground and the main roots should then be dressed with a strong lime sulphur wash, or Bordeaux paste. The main roots should be exposed for some time, not opened up and filled in at once. Young orchards can be set out now, provided the ground is in good order. Don't make the mistake of planting the trees in improperly prepared land—it is far better to wait till the land is ready, and you can rest assured it will pay to do so in the long run.

When planting, see that the centre of the hole is slightly higher than the sides, so that the roots, when spread out, will have a downward, not an upward, tendency; set the tree at as nearly as possible the same depth as it was when growing in the nursery, cut off all broken or bruised roots, and spread those that remain evenly, and cover them with fine top soil. If the land is dry, the tree should then be given a good watering, and when the water has soaked in, the hole can be filled up with dry soil. This is far better than watering the tree after the soil has been placed round it and the hole filled up. Custard apples will be ripening more slowly as the nights get colder, and if the weather becomes unduly cold, or if immature fruit is sent South, the fruit is apt to turn black and be of no value. This can easily be overcome by subjecting the fruit to artificial heat, as is done in the case of bananas

during the cooler part of the year, when it will ripen up properly and develop its flavour. Grade custard apples carefully, and pack in cases holding a single layer of fruit only for the Southern markets.

Pineapples, when at all likely to be injured by frost, should be protected by a thin covering of bush hay, or similar material. The plantation should be kept well worked and free from weeds, and slow-acting manure, such as bone dust or island phosphates, can be applied now. Lime can also be applied when necessary. The fruit takes longer to mature at this time of the year, consequently it can be allowed to remain on the plant till partly coloured before gathering for the Southern markets, or can be fully coloured for local use.

Banana plantations must be kept worked and free from weeds, especially if the weather is dry, as a severe check to the plants now means small fruit later on. Bananas should be allowed to become full before the fruit is cut, as they will carry all right at this time of the year; in fact, there is more danger of their being injured by cold when passing through New England by train than there is of their ripening up too quickly.

Bear in mind the advice given with regard to the handling, grading, and packing of the fruit. It will pay you to do so. Land intended for planting with bananas or pinepaples during the spring should be got ready now.

Strawberries require constant attention, and unless there is a regular and abundant rainfall they should be watered regularly. In fact, in normal seasons, an adequate supply of water is essential, as the plants soon suffer from dry weather, or strong, cold westerly winds. Where not already done, vineyards should be cleaned up ready for pruning—it is, however, too early to prune or to plant out new vineyards.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

All kinds of deciduous fruit trees are now ready for pruning, and this is the principal work of the month in the orchards of the Granite Belt Area. Don't be frightened to thin out young trees properly, or to cut back hard—many good trees are ruined by insufficient or bad pruning during the first three years. If you do not know how to prune, do not touch your trees, but get practical advice and instructions from one or other of the Departmental officers stationed in the district. In old orchards do not have too much bearing wood; cut out severely, especially in the case of peaches, or you are likely to get a quantity of small unsaleable fruit. There are far too many useless and unprofitable fruit trees in the Granite Belt Area which are nothing more or less than breeding-grounds for pests, such as fruit fly, and are a menace to the district. Now is the time to get rid of them. If such trees are old and worn out, take them out and burn them, but if they are still vigorous, cut all the tops off and work them over with better varieties in the coming season—apples by grafting in spring and peaches and other stone fruits by budding on to young growth in summer. Planting can start now, where the land is ready and the trees are to hand, as early planted trees become well established before spring and thus get a good start. Be very careful what you plant. Stock to varieties of proved merit, and few at that, and give so-called novelties and inferior sorts a wide berth. Take the advice of old growers, and do not waste time experimenting with sorts that have probably been tested in the district, and turned down years ago. When land is intended for planting this season, see that it is well prepared and well sweetened before the trees are put in, as young trees seldom make a good start when planted in sour and badly prepared land.

Slowly acting manures—such as bonedust, meatworks manure, or island phosphates —can be applied now, as they are not liable to be washed out of the soil, and they will be available for the use of the trees when they start growth in spring. Lime can also be applied where required. Badly-drained land should be attended to, as no fruit trees will thrive with stagnant water lying round their roots.

On the Downs and Tableland all kinds of fruit trees can be pruned now, and vines can be pruned also in any district where there is no danger from late frosts, and where this can be done the prunings should be gathered and burnt and the vineyard ploughed up and well worked to reduce the soil to a good state of tilth, so that should rain come it will absorb all that falls and the moisture can be kept in the soil by cultivation subsequently.

Citrus fruits will be at their best in the Western districts. The trees should be watered if they show signs of distress, otherwise all that is necessary is to keep the surface of the land well worked. All main-crop lemons should be cut by this time, as if allowed to remain longer on the tree they only become overgrown and are more suitable for the manufacture of peel, whereas if cut and cased now they will keep in good order so that they can be used during the hot weather.

FORTHCOMING SHOWS.

The Queensland Chamber of Agricultural Societies has supplied the following list of show dates for 1924:—

Roma: 20th and 21st May.
Kilkivan: 21st and 22nd May.
Ipswich: 21st to 23rd May.
Emerald: 21st and 22nd May.
Beaudesert: 28th and 29th May.
Gayndah: 28th to 31st May.
Marburg: 2nd and 3rd June.
Hughenden: 3rd and 4th June.
Esk: 4th and 5th June.
Maryborough: 3rd to 6th June.
Childers: 10th and 11th June.
Bundaberg: 12th to 14th June.
Pine Rivers: 13th and 14th June.
Gin Gin: 16th and 18th June.
Woombye: 18th and 19th June.
Gladstone: 19th and 20th June.
Lowood: 20th and 21st June.
Mount Larcom: 21st June.
Rockhampton: 24th, 26th, 27th, and 28th June.
Mackay: 3rd to 5th July.
Kilcoy: 3rd and 4th July.
Biggenden: 3rd and 4th July.
Wallumbilla: 8th and 9th July.
Bowen: 9th and 10th July.
Laidley: 9th and 10th July.
Woodford: 10th and 11th July.
Gatton: 16th and 17th July.
Townsville: 16th and 17th July.
Caboolture: 17th and 18th July.
Sunnybank: 19th July.
Barcaldine: 22nd and 23rd July.
Charters Towers: 23rd and 24th July.
Rosewood: 23rd and 24th July.
Ithaca: 25th and 26th July.
Nambour: 30th and 31st July.
Ayr: 1st and 2nd August.
Mount Gravatt: 2nd August.
Humpybong: 7th August.
Royal National: 11th to 16th August.
Gympie: 20th and 21st August.
Belmont: 23rd August.
Imbil: 27th and 28th August.
Coorparoo: 30th August.
Crow's Nest: 4th September.
Wynnum: 6th September.
Beenleigh: 11th and 12th September.
Zillmere: 13th September.
Stephens: 20th September.
Rocklea: 27th September.
Kenilworth: 2nd October.
Toombul: 3rd and 4th October.
Southport: 10th October.

INSECT ATTACK ON STANDOVER COTTON.

A sample of one hundred green bolls three-quarters grown was taken recently from a standover crop in the Rockhampton district. These bolls were picked at random. The cotton was growing among the stumps and was not free of weeds.

The following figures are not without interest and give the results of the examination of the sample:—

No. of sound bolls, 27—	
Attacked by maize grub (*Chloridea obsoleta*, Say.)	2
Attacked by peach grub (*Dichocrocis punctiferalis*, Guen)	15
Attacked by pink boll worm (*Platyedra gossypiella*, Saunders) ..	13
Attacked by boll rot apparently following on insect punctures ..	26
Attacked by boll rot punctures not seen	4
Attacked by boll rot just beginning	3
Unidentified insect attack	10
Total damaged from all causes	73

In every case of boll worm attack from any of the three species concerned, boll rot had set in, destroying two, three, or four locks. Some allowance must always be made for human error in sampling, but in the case of pink boll worm attack this does not apply, as no trace of attack can be seen until the boll is opened.—E. Ballard, Cotton Entomologist to the Commonwealth Government.

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON, F.R.A.S.

TIMES OF SUNRISE AND SUNSET.

AT WARWICK.

1924.	APRIL.		MAY.		JUNE.	
Date.	Rises.	Sets.	Rises.	Sets.	Rises.	Sets.
1	6·4	5·48	6·20	5·18	6·37	5·2
2	6 4	5·47	6 21	5·17	6·38	5·2
3	6 5	5·46	6·21	5·16	6 38	5·2
4	6·5	5·45	6 22	5·15	6·39	5 1
5	6 6	5·44	6 22	5·14	6·39	5·1
6	6·6	5·43	6·23	5·13	6·40	5·1
7	6 7	5 42	6 23	5·13	6·40	5·1
8	6·7	5 41	6 24	5·12	6·41	5·1
9	6 8	5·40	6·24	5·12	6·41	5·1
10	6·8	5·39	6 25	5·11	6·41	5·1
11	6·9	5·37	6 26	5·11	6·42	5·1
12	6 9	5·36	6 26	5·10	6·42	5·1
13	6·10	5·35	6·27	5·10	6·42	5·1
14	6·10	5·34	6·27	5·9	6·42	5 2
15	6·11	5 32	6·28	5·8	6·43	5·2
16	6·11	5 31	6·29	5·8	6·43	5·2
17	6 12	5 30	6·29	5·7	6·43	5·2
18	6·12	5·29	6·30	5·7	6·43	5·2
19	6·13	5·28	6·30	5·6	6·44	5·2
20	6·14	5·27	6·31	5·6	6·44	5·2
21	6·14	5·26	6 31	5·5	6 44	5 2
22	6·15	5 25	6·32	5·5	6·44	5 3
23	6·15	5·24	6·32	5·4	6·44	5·3
24	6·16	5 23	6·33	5 4	6·45	5·3
25	6·17	5·22	6·34	5·4	6·45	5·4
26	6·17	5 21	6·34	5·3	6·45	5 4
27	6·18	5·21	6·35	5·3	6 45	5·4
28	6 18	5 20	6 35	5·3	6·45	5·5
29	6·19	5·20	6·36	5·3	6 45	5·5
30	6·20	5·19	6·36	5·2	6·46	5·6
31	...	...	6·37	5·2	...	...

Phases of the Moon, Occultations, &c.

The times stated are for Queensland, New South Wales, Victoria, and Tasmania, when "Summer" Time is not used.

4 Apr. ● New Moon 5 17 p.m.
12 ,, ☾ First Quarter 9 12 p.m.
20 ,, ○ Full Moon 12 10 a.m.
26 ,, ☽ Last Quarter 2 28 p.m.

Apogee 9th April, 1·12 a.m.
Perigee 21st April, 6·18 a.m.

On 8th April, between 2 and 3 p.m., the planet Venus will be very near the moon, on its left hand side. The moon will occult it by passing between the earth and the planet before 4 p.m. This should be an interesting spectacle, especially to those who have a telescope or binoculars; even without, the planet should be visible.

On 14th April, the moon will occult Regulus, the brightest star of Leo, between 6 and 7 p.m. The emergence of the planet soon after seven may be observed with binoculars.

The occultation of Uranus on the 29th, about 2 p.m., will be only visible in a telescope.

4 May ● New Moon 9 0 a.m.
12 ,, ☾ First Quarter 12 13 p.m.
19 ,, ○ Full Moon 7 52 a.m.
26 ,, ☽ Last Quarter 12 16 a.m.

Apogee 6th May, 12·0 noon.
Perigee 19th May, 3·18 p.m.

Regulus will again be occulted by the moon about 3 o'clock in the morning of the 13th of May.

The great astronomical event of May is the transit of Mercury, on the 8th, when the planet passing between the earth and the sun, will cross the sun's face from right to left, but in an upward direction. The commencement of the transit will be at 7·47 a.m. when the planet will reach the lower edge of the sun's disc. It's slow progress will continue until 3·35 p.m. when the sun's opposite limit will be considerably inclined over to the west.

Great care must be taken when attempting to look at the sun that the eyes are protected *very* carefully by *very* dark-coloured or smoked glass.

3 June ● New Moon 12 33 a.m.
10 ,, ☾ First Quarter 11 36 p.m.
17 ,, ○ Full Moon 2 41 p.m.
24 ,, ☽ Last Quarter 12 16 p.m.

Apogee 2nd June, 3·24 p.m.
Also Apogee 29th June, 9·24 p.m.
Perigee 17th June, 1·6 p.m.

The planet Mercury will be a morning star in June being at its greatest distance, west of the sun, on the 4th.

After Mercury being a morning star, Jupiter will be an evening star, rising, in the early part of the month, somewhere about the time of sunset.

Saturn being in conjunction with the moon on 12th of June, will appear about 2 p.m. on the left of the moon, but somewhat higher during the evening hours.

On 16th June, Mercury will be above the moon, distant about eight times its diameter, about 7 p.m.

On 22nd June, The Solstice, the sun, when having reached its furthest northern point in the sky, appears to stand still before turning southwards.

Saturn, on 30th June, will appear stationary, after which it will appear to be moving again east in its normal direction.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S., add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhere about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

CHEESE BOARD.

Department of Agriculture and Stock,
Brisbane, 15th May, 1924.

IN pursuance of the provisions of "*The Primary Products Pools Acts*, 1922 *to* 1923," notice is hereby given that it is the intention of the Lieutenant-Governor, acting as Deputy for and on behalf of his Excellency the Governor, in Council, upon the recommendation of the Council of Agriculture, to make the Order in Council set out in the Schedule hereto.

Dated this fifteenth day of May, 1924.

W. FORGAN SMITH.

SCHEDULE.

ORDER IN COUNCIL.

At the Executive Buildings, Brisbane, the day of , 1924.

Present:

The Lieutenant-Governor, acting as Deputy for and on behalf of His Excellency the Governor, in Council.

CHEESE BOARD.

WHEREAS by "*The Primary Products Pools Act of* 1922" it is amongst other things provided that the Governor in Council, upon the recommendation of the Council of Agriculture, may from time to time, or if requested so to do by a petition signed by a representative number of growers of any particular commodity or by an organisation representing the growers of that commodity, by Order in Council, declare that any grain, cereal, fruit, vegetable, or other product of the soil in Queensland, or any dairy produce (including butter and cheese) and eggs or any article of commerce prepared other than by any process of manufacture from the produce of agricultural or other rural occupations in Queensland, is and shall be a commodity under and for the purposes of that Act; and may by the same or a subsequent Order in Council constitute a Board in relation to the commodity so declared, and extend the provisions of that Act, either wholly or with all such modifications thereof or additions thereto as are deemed by him necessary to meet the particular circumstances, to such commodity and the Board so constituted, and all persons, things, and matters concerned; and that by any such Order in Council the classes of persons who shall be deemed to be growers of such commodity and the method of choosing the representatives of such growers may be declared: Now, therefore, the Lieutenant-Governor, acting as Deputy for and on behalf of His Excellency the Governor, and with the advice of the Executive Council, upon the recommendation of the Council of Agriculture, doth hereby order and declare that—

1. Cheese produced in Queensland is and shall be a commodity under and for the purposes of the above-mentioned Act, from the First day of July, 1924, until and including the Thirtieth day of June, 1927.

2. There is hereby constituted a Board, consisting of five members together with a person to represent the Council of Agriculture, in relation to such commodity.

3. The provisions of the said Act, with the following modifications and additions, are hereby extended to such commodity and the Board so constituted and all persons, things, and matters concerned—

(*a*) With the addition of the following provision:—

I.—Notwithstanding anything in this Act contained, the Minister, upon the recommendation of the Board, may from time to time direct, by notification in the *Gazette*, that no person shall deliver any cheese to the Board before a date mentioned in such notification. Thereupon the following consequences shall ensue until the date mentioned in such notification, that is to say:—

(i.) On Monday in every week—

(*a*) Every producer shall deliver to the Board a return in the prescribed form showing the total quantities of each description of cheese manufactured by him during the last preceding seven days, and the names and addresses of all persons to whom any cheese was during such period delivered or consigned by such producer for sale, and the respective quantities of the cheese so delivered or consigned to each such person and the respective descriptions thereof;

(*b*) Every agent for the sale of cheese shall deliver to the Board a return in the prescribed form showing the respective quantities of each description of cheese sold or agreed to be sold by him on behalf of any person during the last preceding seven days, and the price realised or agreed to be paid in respect of such respective quantities of cheese, and the names and addresses of the persons on whose behalf such respective quantities of cheese were sold or agreed to be sold, and such further particulars relating to such sales as the Board may from time to time require.

(ii.) If the Board is satisfied that any producer has sold in Queensland more cheese than his quota as determined by the Board, the Board may, by written notice in the prescribed form addressed to such producer, direct that such producer shall purchase cheese of the grade or description and in the respective quantities specified in such notice from such person and at such place and within such time as shall be specified in such notice: Provided that such last-mentioned person is willing to sell such cheese at the wholesale price of cheese of such grade or description then prevailing in such place. Any statement in such notice as to such wholesale price shall be *primâ facie* evidence of such price.

Any producer who fails to comply with any such direction of the Board shall pay to the Board a sum equal to the value of the cheese so directed to be purchased by such producer and which he has failed to purchase as so directed. Such sum shall be a debt due to the Chairman of the Board, and may be recovered by him in any Court of competent jurisdiction by proceedings in his official name of "Chairman of the State Cheese Board," and shall be paid by him to the person from whom such purchase was so directed to be made, provided such last-mentioned person delivers such cheese to the Board or as directed by the Board to be disposed of to or for the benefit of the producer who failed to purchase the same as aforesaid.

(iii.) The Minister may from time to time appoint, by writing under his hand, any person or persons authorising him or them to inspect and take copies of any books, papers, vouchers, records, or other documents of any producer or agent of a producer for the purpose of ascertaining or verifying any of the particulars prescribed to be included in any return under this section by such producer or agent, and for that purpose authorising the person or persons so appointed to enter into or upon any office or premises of such producer or agent; such producer or agent shall provide all reasonable facilities for such entry, inspection, and copying; such producer or agent, and every officer, agent, or servant of such producer or agent, shall furnish to the person or persons so appointed all such information in the power of such producer or agent or officer, agent, or servant of such producer or agent, as the case may be, as may reasonably be requested of him.

II.—(*a*) Every merchant, person, firm, or company who or which is a wholesale dealer in cheese shall make application to the Minister for a license to trade in such cheese, giving such information as may be required to enable the Minister to determine the application for such license. The Minister, on the recommendation of the Board, may refuse to grant or may withhold any license, or may withdraw or suspend any such license, without assigning any reason therefor. Every grower, authorised agent, and licensed wholesale dealer shall forthwith, when requested by the Board, supply to the Board as soon as may be practicable any information concerning stocks of cheese held at any time, and shall also furnish on demand any other information concerning contracts for sale, prices fixed by such contracts, and other matters relating thereto, which the Board may require for the purpose of the administration of this Act or the Regulations made thereunder. And

(*b*) With the modification that paragraph (*d*) of subsection 1 of section 21 is hereby deleted, and the following is inserted in lieu thereof:—

"Ascertaining whether cheese is of merchantable quality, and prescribing a standard therefor, and for an increase or decrease in the price otherwise payable to any grower for any cheese delivered by him to the Board according to the extent to which such cheese is graded above or below ninety points by a State grading officer; and regulating the storage, package, marking, branding, grading, carriage, exporting, and delivery of cheese."

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4. The persons who shall be deemed to be growers and eligible to vote at any referendum or election in connection with the said Board prior to the Thirtieth day of June, one thousand nine hundred and twenty-four, shall be—

(*a*) Persons, partnerships, firms, or bodies of persons, corporate or unincorporate, who at any time during the period from the first day of January, one thousand nine hundred and twenty-four, until the date of such referendum or election produced or produce cheese for sale;

(*b*) Dairy farmers who at any time during the period from the first day of January, one thousand nine hundred and twenty-four, until the date of such referendum or election supplied or supply milk to a cheese factory.

5. The persons entitled to vote at any subsequent referendum or election in connection with the said Board shall be—

(*a*) Persons, partnerships, firms, or bodies of persons, corporate or unincorporate, who at any time during the six months immediately prior to the date of such referendum or election produced or produce cheese for sale;

(*b*) Dairy farmers who at any time during the six months immediately prior to the date of such referendum or election supplied or supply milk to a cheese factory.

And the Honourable the Secretary for Agriculture and Stock is to give the necessary instructions herein accordingly.

Clerk of the Council.

NOTES.—1. Any petition for a Poll to decide whether the above Order shall be made must be signed by at least fifty cheese producers or dairy farmers supplying milk to a cheese factory, and must reach the Minister before the Twenty-fifth day of June, 1924.

2. To insure their names being on the roll of persons eligible to vote, dairy farmers who have supplied milk to a cheese factory at any time since the 1st January, 1924, are invited to send their names and addresses and factories supplied at once to the Under Secretary, Department of Agriculture and Stock, Brisbane.

Department of Agriculture and Stock,
Brisbane, 15th May, 1924.

NOTIFICATION.

CHEESE BOARD.

NOMINATIONS will be received by the Under Secretary, Department of Agriculture and Stock, Brisbane, until noon on the Eleventh day of June, 1924, for the Election as Growers' Representatives on the Cheese Board.

Five such representatives are to be elected by growers as defined in the notice in the *Government Gazette* of the 17th May, 1924, a copy of which appears above.

Each nomination is to be signed by at least ten growers in accordance with the terms of the notice.

ERNEST G. E. SCRIVEN, Under Secretary,
Department of Agriculture and Stock, Brisbane.